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EIGHTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK
Agricultural Experiment Station,

(GENEVA, ONTARIO CO.)

FOR THE YEAR 1889,

WITH REPORTS OF DIRECTOR AND OTHER OFFICERS.

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No. 9.

IN ASSEMBLY,

FEBRUARY, 1890.

REPORT

OF THE

BOARD OF CONTROL OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION.

Hon. JAMES W. HUSTED, *Speaker of the Assembly:*

SIR.—I herewith transmit to the Legislature the Eighth Annual Report of the New York Agricultural Experiment Station.

Very respectfully,
Your obedient servant.
N. M. CURTIS,
President Board of Control.

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1889.

ORGANIZATION OF THE STATION.

BOARD OF CONTROL.

DAVID B. HILL, *Governor*	Albany.
N. M. CURTIS, *President*	Ogdensburgh, St. Lawrence Co.
JAMES McCANN	Elmira, Chemung County.
W. A. ARMSTRONG	Elmira, Chemung County.
W. W. WRIGHT,*	Geneva, Oneida County.
CHARLES JONES	Geneseo, Livingston County.
DANIEL BATCHELOR	Utica, Oneida County.
G. S. MILLER	Peterboro, Madison County.
GEO. F. MILLS	Fonda, Montgomery County.
W. C. BARRY	Rochester, Monroe County.

STATION OFFICERS.

Director	PETER COLLIER, A. M., M. D., Ph. D.
First Assistant	WILLIAM P. WHEELER.
Chemist	E. F. LADD.
Assistant Chemist	W. H. WHALEN.
Farm Superintendent	F. E. EMERY.
Acting Horticulturist	C. E. HUNN.
Farmer	G. W. CHURCHILL.
Stenographer	FRANK E. NEWTON.

Post-office address: Geneva, Ontario county, N. Y.

* Deceased.

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EIGHTH ANNUAL REPORT

OF THE

Board of Control of the New York Agricultural Experiment Station.

REPORT OF THE EXECUTIVE COMMITTEE.

In pursuance of a resolution of the board at their last meeting, that the plans submitted for their consideration by the director should be substantially carried out, for which purpose and others an appropriation of $10,860 was made by the last Legislature, enumerating the following items for which provision was made, bulletins, salaries of herdsman, assistant herdsman, poultryman, clerical assistant, library, farming and scientific implements, farm improvement, microscopical division, clerical division, manure platform, poultry house and piggery, your executive committee have the following report to submit:

There has been expended for bulletins, $356.45; for farming and scientific implements, $712.47; for farm improvement, $503; for the clerical division, $47.50; for the manure platform, $983.98 for the piggery and poultry-house, $3,068.58; and for salaries, $648.

Your committee found that the condition of the old barn was such as to require practically entire reconstruction, especially of that portion known as the "old cattle barn," the timbers being decayed, and the foundation walls in a tottering condition, so that most of them required entire removal. The basement of the two barns has afforded ample room for all the requirements of a well-appointed piggery with twenty-four pens arranged in such a manner that they may be readily cleaned and the liquid manure secured without loss or trouble. The upper portion of these barns adds very largely to the storage capacity for grain, hay and farm implements, and for the latter purpose it is now being utilized.

The old cattle barn and the one adjacent has been entirely resided, and it seemed best to place a metal roof over the three barns thus repaired, although adding very considerably to the expense. In fact it will be seen that we have practically substituted new barns for the old tumble-down structures which so disfigured the grounds of the Station. There have been placed two gable windows upon the old cattle barn, and a cupola upon the tool barn, which adds greatly to the architectural effect of the whole series of buildings, which being painted alike present a not unattractive appearance.

Secure stalls for five bulls have been built, the liquid manure from which flows into a system of vitrified tile drains which are also connected with the pig pens and stables for cattle in the new barn. By this means the liquid manure is brought into a series of reservoirs beneath the manure platform (36 by 100 feet) south of the new barn. Upon this platform, which has a foundation of cobble stone and grout finished off with cement, the manure from the different stables is stacked. It is estimated that the saving of fertilizing material from fifty cattle by means of this contrivance will in a single year repay the entire expense of the platform.

A new poultry-house has been constructed, with all the modern conveniences for testing standard breeds of fowls. Already experiments are in progress for the purpose of ascertaining the actual and relative cost of producing eggs and fattened poultry.

All the barns and the out-house fences connected with the Station have received a coat of paint, which has greatly improved their appearance.

The roads and drive-ways about the barns have been graded and graveled.

Pig yards in connection with the pens alone await completion before the work directed by the board at their last meeting shall have been fully accomplished.

There have also been constructed eight paddocks, southeast of the new barn, to provide out-of-door exercise for the several breeds of cattle which have been secured for purposes of experimental investigation by the Station.

During the progress of the work your committee have repeatedly visited the Station, and advised with the director as to its prosecution.

JAMES McCANN,
CHARLES JONES,
Executive Committee.

GENEVA, N. Y., *Nov.* 6, 1889.

TREASURER'S REPORT.

To the Board of Control of the New York Agricultural Experiment Station:

As treasurer of the board of control, I do respectfully report:

That I have received from the Treasurer of the State of New York for the twelve months ending September 30, 1889	$26,500 00
That the balance on hand, October 1, 1888, was	509 06
Total	$27,009 06

And I do further report that I have expended during the twelve months ending September 30, 1889, the sum of $26,988.73, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Botanical department	$11 50
Farm	830 09
Farm implements and tools	222 33
Freight, cartage and express	542 39
Fuel	382 80
Furniture	110 80
Labor	7,487 98
Laboratory department	379 48
Library	112 08
Live stock	116 00
Manure and fertilizer	333 22
Meteorological department	65 40
Carried forward	$10,594 07

Brought farward	$10,594 07
Permanent improvement	2,681 46
Postage expenses	420 24
Printing	250 80
Repairs	567 04
Salaries	8,819 92
Scientific apparatus	33 60
Stationery	227 11
Sundries	82 64
Supplies	1,865 86
Travel	360 14
Board of control	822 55
New barn	263 30
	$26,988 73
Balance on hand	20 33
	$27,009 06

And I do further report that I have expended $5,501.98, the balance, September 30, 1888, of the special appropriation of $8,000, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Farm implements and tools	$100 00
Live stock	99 98
Scientific apparatus	164 03
New barn account	5,103 47
Manure and fertilizer	34 50
	$5,501 98

And I do further report that I have received from the Treasurer of the State of New York, on account of special appropriation, $10,860; that I have expended on this account $5,680.46, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Bulletins	$356 43
Farming and scientific implements	715 47
Farm improvement	503 00
Clerical division	47 50
Manure platform	983 98
Poultry-house Piggery	3,074 08
	$5,680 46
Balance on hand	5,179 54
	$10,860 00

WM. O'HANLON,
Treasurer.

DIRECTOR'S REPORT.*

To the Board of Control of the New York Agricultural Experiment Station:

GENTLEMEN.— I herewith submit the eighth annual report of the Experiment Station for the calendar year 1889.

By reference to the report of the executive committee of the board of control, it will be seen that during the past year there have been made extended improvements in the buildings of the Station, involving the practical reconstruction of several, and the erection of one for the purpose of increasing our facilities in the work of investigation.

These repairs have been mainly carried forward under the personal supervision of the director, and have largely engaged him during the season. In fact, while the routine work of the Station has been carried forward during the past year, and important investigations conducted in the laboratory, in the feeding pens, and upon the farm, as will be seen by reference to this report, it has been rather a year of preparation for what it is hoped may be even more valuable work in the future.

A large amount of additional work in the field, stables and laboratory, is involved in the investigations in progress with the individuals of the several breeds of dairy cattle, which have been secured, but that the practical results which are sure to come from such work will fully justify this additional care and expense no one can question who is at all familiar with the problems which await solution in connection with this industry.

In fact, the entire dairy industry is environed with practical questions which can only be solved by long continued and carefully conducted experiment and investigation, such as our several stations are competent to carry forward, under the advice, suggestion, and if necessary coöperation of the dairymen themselves who are chiefly to reap the benefits of the work.

---

*Peter Collier, A. M., M. D., Ph. D.

It is obvious that maximum production is not always and, perhaps, rarely associated with maximum profit, even with the same individual or different animals of the same breed.

While an abundant product of milk is, of course, desirable, the practical question is to what extent may an increase of product be carried along with increase of profit.

Already enough is known to enable the dairyman to increase the quantity and improve the quality of milk by changes in feeding; but the effects of certain kinds of food, even those very closely allied in chemical composition, is an important subject for further investigation. Again, while, perhaps, it may be considered probable, it is by no means established that the same ration will prove, either for different individuals or for different breeds, the most productive and economical. It is by no means improbable that in the future there will be a classification of those generally admitted as good dairy cows, which will determine their treatment and feeding, based on other qualities than those of breed merely.

No one can have carefully observed a herd of animals without remarking individual characteristics, which alone distinguish them, and which, being recognized and considered by the intelligent herdsman, may largely determine the relative value of such animals for the dairy. To illustrate, who has failed to contrast the stolid, good-natured, easy-going cow, with the highly-strung, nervous and excitable companion, even in the same stable and subject to like conditions; and who can doubt that two such require differences of management, extending possibly to great detail, for the attainment of the best results with each?

The importance of this matter appears to have been clearly demonstrated at a recent dairy contest at one of our State fairs, where it was found that three Jersey cows gave upon an average eleven per cent less milk per day at the fair, than they did ten days later after being returned to their customary quarters; further, this milk contained seventeen per cent less total solids, and the amount of fat in the milk was upon an average thirty-two per cent less at the fair than when at home. Three Ayrshire cows at the same trial gave thirteen per cent less milk containing thirteen per cent less total solids and nine per cent less fat at the fair than they did ten days later at home.

DAIRY STATISTICS.

Owing to the importance of the dairy industry in our State, and in the hope that, by learning so far as possible the practice among our dairymen and the corresponding results, improved methods might be suggested and prevalent errors corrected, in order that greater profit might accrue to this branch of agriculture, there were sent out from the station over 1,500 circulars, of which the following is a copy, together with a circular letter urging the importance of this investigation especially to those engaged in this industry. It was hardly to be expected that many of our dairymen could answer more than a small number of the several questions asked in the circular, and yet I think all will agree that it would be greatly to their interest that they should so intelligently conduct their business as to be able to satisfactorily answer the most if not all of them.

NEW YORK STATE DAIRY STATISTICS.

No ....
Name................ ....
Post-office ....
Breed of cows...
How long do your cows go dry?................................
At what season do your cows come in milk?......................

Summer Expense for Cows.

Number of cows during summer, ...
Pasture, grazed by cows, ... acres.
Green forage fed cows at pasture, ... acres.
Hay fed cows at pasture, ... tons.
Grain fed cows at pasture, ... tons.
Average daily milk yield in summer, ... pounds or .... quarts.

Winter Expense of Cows for 1888–89.

Number of cows wintered, ...
Fed cows during winter:
Hay, ... tons; value, ...
Ensilage, ... tons; value, ...
Fodder, corn, ... tons; value, ...
Corn stover, ... tons; value, ...
Straw, ... tons; value, ...
Other rough fodder, ... tons; value, ...
Corn meal, ... tons; value, ...

Wheat bran, ... tons; value, ...
Cotton-seed meal, ... tons; value, ...
Linseed meal, ... tons; value, ...
Other grain, ... tons; value, ...
Potatoes or roots, ... tons; value, ...
Average daily milk yield in winter, ... pounds or ...... quarts.

Income from Cows for One Year.

Calves, number, ...; value, ...
Deacons, number, ...; value, ...
Milk produced, ... pounds, or ...... quarts; value, ...
Milk sold, ... pounds, or ...... quarts; value, ...
Butter produced, ... pounds, or ...... quarts; value, ...
Cheese produced, ... pounds; value, ...
Skim-milk, ... pounds, or ...... quarts; value, ...
Value farm per acre, ...
Taxes, ...

Please indicate in the list enumerated below about the amount you are in the habit of feeding each cow per day during the winter:

Hay (clover or mixed grasses) ....
Ensilage ....
Roots ....
Straw ....
Corn stover or fodder ....
Corn meal ....
Wheat bran ....
Wheat middlings ....
Oats ....
Cotton-seed meal ....
Linseed meal ....
Other grains ....

It is to be regretted that thus far the replies have not been so numerous as to warrant the presentation of anything like an adequate generalization at this time, but already the data is sufficient to show that it is not due to any one unfavorable condition that ill success so frequently results in this branch of agriculture, and our dairymen should consider that the greatest success can only attend upon the fulfillment of all the many conditions of success which environ the practice of dairying.

Here and there native herds far surpass in their products those secured from other herds of excellent grades, showing that intelligent selection and greater care far more than outweigh the advantage even of an improved breed. Indeed one might easily make it appear established from actual facts that selection was of even greater value than breed, since it is now freely admitted that the Short Horns have in late years largely lost their value for the purposes of the dairy through a neglect to develop and perpetuate the valuable milking qualities of this famous breed of cattle; while several other breeds, the ancestors of which probably a century ago, gave as great promise as did any of the progenitors of many of the most notable dairy breeds of to-day, have by disregard of these valuable milking qualities, come to be, through years of selection directed to the production of beef, absolutely worthless to the dairy. It is probably safe to say that an intelligent dairyman and breeder could to-day select a herd of twenty cows at random from most of our dairies and by selection alone of those of their offspring best fitted for the production of milk, easily double the average product of such offspring within twenty-five years, and probably in even less time. Certainly, when we consider with what care those breeders of the choicest breeds, attend to this matter of selection, we may be confident that they at least do not wholly rely upon breed alone.

Scarcely secondary in importance to selection is the subject of intelligent feeding, and it is hoped that an examination of the data submitted in this report will lead to a more rational, liberal and economical method of feeding than that too often practiced. Our dairymen should understand that simply a maintenance ration for their animals, while sometimes it may be necessary, can never be a source of profit, and that it is only from the judicious, economical increase of feed beyond the point of maintenance that profit may be secured. But even worse is it, when, through the temptation of high prices, or the need of ready money, the farmer is led to sell from his farm those supplies of food, which should be retained to carry his stock in good condition through the winter, impoverishing thus not only his stock but his farm.

FUNCTION OF FOOD.

It is obviously of first importance that our farmers should have as clear an idea as possible as to the several functions of food in order that they may furnish to their animals a ration most suitable for their wants and most economical to the farmer.

We may regard the food as providing the heat necessary to maintain the temperature of the body and it is obvious that if provision is made that the care of and the surroundings of the animal are such that no unnecessary demand be made for such purpose, it must result in a saving to the farmer. The most prominent methods of economy in this regard, are in providing comfortable winter quarters and warm water for drink, but in regard to this last arises the question of extra cost in heating the water, as also the effect upon the animal of furnishing warm water for drink.

It seems safe to say that there is economy in making such provision in this particular that cattle shall be provided with a supply of water during winter at a temperature not much below that of their winter quarters and that these latter should be such as to be entirely comfortable to both man and beast.

In addition to this demand for food to maintain animal heat, there is also required a large amount to provide the necessary muscular force needed in the internal economy of living, as also that manifested in outward and visible effort, as of a working horse or ox. But muscular exercise of any sort makes ultimately a demand upon the food for its continuance, and it is a well-known fact, which the feeding experiments elsewhere detailed fully corroborate, that any cause which results in increased effort upon the part of the animal also produces its effect upon the quantity of food consumed. For example, it will be seen that while during the warm months of summer and autumn the food needed for sustaining animal heat was at a minimum, and while the food eaten and digested was practically constant, the effect of food as resulting in increase of weight of our young animals was subject to very marked differences in the case of every animal fed, and amounting in many cases to fully double the quantity at one period over that required at another.

It would appear that this marked difference arose mainly, if not entirely, from the annoyance to which the animals were subjected and their consequent restlessness during that portion of the season when the flies were most troublesome.

It is obvious therefore that any precaution which may be taken to diminish such annoyance by keeping the animals during the hotter part of the day in cool and darkened stables, is in the interests of economy.

In addition to the demands for food already mentioned, there remains the necessary amount required to repair the constant waste of flesh and bone which is going on in the animal, the material needed to build up the growing animal, and with the female the production of milk and the development of the fœtus.

In providing for these several demands of the animal it is difficult, if not impossible, to trace the complex chemical changes which go on within the animal, and to determine with rigorous accuracy the function of the several constituents of the food, but careful experiments may enable us to learn what is at least probable, and lead to valuable practical results in pointing out the manner of feeding with greatest economy.

If we take the case of the cow Nellie for consideration we find that she digested of the total dry matter of her ration, of which 64.64 per cent was hay and 35.36 per cent grain, 62.73 per cent. Of the total ash 33.0 per cent; of the albuminoids 65.2 per cent; of the carbohydrates 67.4 per cent; of the fats 70.8 per cent, and of the fiber 44.3 per cent of the amount present in the total ration was digested.

There was found in the milk product a certain portion of nitrogenous matter (casein), carbohydrates (sugars), fats (butter) and ash.

There was also found in the urine a certain portion of nitrogenous matter, and smaller amounts of other organic and inorganic matters.

We may compare the amount of the several food constituents digested with the similar products found as follows:

	Albuminoids.	Carbohydrates.	Fats.	Fiber.
	Ounces.	Ounces.	Ounces.	Ounces.
Digested	41.3	147.7	13.9	47.5
Found	40.9	14.5	19.1	....

Upon a first view of the above it would appear that the albuminoids digested practically supplied the demand of the animal for this constituent of food, that the supply of fats in the food was unequal to the amount secured in the milk, which deficiency it would seem was made up by the carbohydrates which were present in the food greatly in excess of the apparent demands, and, owing to the chemical composition of those two compounds, it is not improbable that the excess of fat was thus provided. At least the production of so-called body-fat from food rich in carbohydrates is one of the accepted facts of those who feed for fattening.

But there remains yet, supposing that the deficiency in fat is made up from carbohydrates, a large amount of carbohydrates and fiber which is unaccounted for, a trifle over seventy per cent of the organic food digested.

This amounts to 175.8 ounces daily, but as we have already seen, the greater portion of the food digested by the animal is expended in maintaining animal heat and as a source of muscular power, directly, as is more than probable, indirectly, as is not impossible, and yet it is to be remembered that the degree of muscular force exerted is more nearly measured by the amount of carbon oxidized and exhaled than by any other product. Now this cow would consume for such purpose, according to the estimate given (p. 22 159.2 ounces of carbohydrates daily, thus leaving of her digested food but a fraction over a pound, 16.6 ounces daily, unaccounted for, an amount certainly within the limits of error in such an experiment, as it is but five per cent of the digested, and 3.6 per cent of the total dry matter in the food eaten.

New York is the leading dairy State of the Union. The annual report of the Department of Agriculture for 1888 gives the number of milch cows in New York January 1, 1889, as 1,552,373, valued at $45,950,241, and Iowa stands next in the list with 1,293,095, valued at $28,861,880. The dairy products of the State are estimated at $44,000,000, and the aggregate capital invested in dairying in the State, including value of animals, land, dairy buildings and implements, has been estimated as high as $400,000,000.

The Experiment Station was wisely established "for the purpose of promoting every branch of agriculture by scientific investigation and experiment," and it would seem that in no field of experimental investigation could the Station more wisely direct its efforts than in behalf of our dairy interests.

The following circular was issued shortly after the present director entered upon his work, and was sent to the leading breeders of cattle throughout this and other States, since it appeared that the contemplated work of investigation could not but be of direct value to the entire dairy interests of the country.

NEW YORK AGRICULTURAL EXPERIMENT STATION.

Upon assuming the directorship of this Station, it has occurred to me that there was a wide field for careful scientific investigation which could not but prove of immense practical value to the agricultural interests of the State, and especially to the dairy interest, which, I need not inform you, is of almost preëminent importance to our people.

I beg leave to submit to your consideration the following points which have occurred to me, and shall be happy to receive from you any suggestions, by way of criticism, of the plan proposed, or of amplification of the details of the proposed investigation.

I shall be pleased to have your suggestions as to how I may secure most economically, for the Station, the animals needed for the purpose of such investigation and experiments, and any information which shall tend to make the results of the highest value to the people of the State.

1. At a public institution, devoted to the advancement of agriculture through experimentation, the stock should be representative animals of the breed from which they are selected.

2. The dairy interest in New York State being the most important branch of the stock industry, it should be the first to receive attention.

3. The average butter yield per cow, in this State, does not exceed 130 pounds per year, whereas it should not fall below 300 pounds. This being true, the Station can do no better service for the dairymen of the State than to unite with them in working out the problem of feeding, individual variations and breed characteristics, with the allied subjects, which, when better understood and practiced, shall help to raise the standard and bring the yield up to double the present amount.

4. The breeds which should first be selected are the Jersey, Holstein, Guernsey, Ayrshire, Shorthorns, Devon and one or two of the polled breeds.

5. In building up a herd to be used in experimental work young animals should be selected, animals under one year, or, better, but a few months old. By having young animals, under like feeding, they can be grown to maturity, making the conditions for all the same, so that experiments with these animals would be much more valuable and conclusive than if their earlier feeding and environments had been widely different.

6. The yearly growth of the animals, under like conditions and feeding, and the amount of food consumed for the several breeds, in proportion to their live weight, is of value and importance to the dairymen and would form a part of the trial.

7. At least four animals of each breed should be had, two heifers and two steers. The two heifers from each breed would be the beginning for a herd, finally enabling us to study the breed characteristics in production of milk and butter. Two steers from each breed, fed and grown to maturity and fattened, would show much as to the relative values of the dairy breeds for beef.

8. The question, which is the more profitable for the dairy, a small cow or a large one, is of much importance. And what place is better fitted to investigate this subject than an experiment station?

9. Whether, with two foods of similar composition, both will affect equally the milk and butter yield, or whether one will tend more to the production of body fat and less to an increase of milk.

10. The influence of the various grains fed separately and combined in rations, and to what extent the chemical and physical properties of butter are influenced by different foods.

I have but briefly indicated the general scope of the proposed investigation, but I can not but think it will meet your entire approval and receive your coöperation and that of your associates in this important branch of our agricultural industry.

The above statement of the plans proposed to be carried out at the Agricultural Experiment Station, in every instance, has met with cordial approval, and the assurance of sympathy and coöperation with the Station in its efforts to carry forward this investigation.

I quote the remarks of Mr. E. A. Powell of Smith's, Powell and Lamb of Syracuse, who, at the annual meeting of the Holstein-Friesian Association, held at Buffalo, submitted the matter to the Association and spoke in hearty approval of the plan, as follows:

MR. POWELL.—I will say that the scope of the experiments is broad; it takes in nearly everything—or is intended to take in everything—for which a breed of cattle is used. It seems to me that we have a breed of cattle that is better adapted to make a fine showing in that respect than any other. I also feel that experiments in this line will be of greater value than almost any others that can be made with any breed of cattle. This matter has been brought to our attention before it has been acted upon by any of the other associations, and it seems to me that prompt and favorable action on the part of this body would tend to place us before that institution in a favorable light, showing our hearty cöoperation, and we would not fail to get a fair and just, and it seems to me a valuable, report, which would be to the advantage of our breed, providing we can furnish the right animals. The important thing to be considered is the kind of animals we shall furnish. He does not ask us to contribute any animals, but he asks us in what manner animals may be obtained by the Experiment Station at the least possible expense. If it is left for those gentlemen to purchase their own cattle, I am afraid they will not purchase as judiciously as it is for the interest of this association to have it done, and it seems to me proper to refer this matter to the board of officers, to make such selection of animals as they deem best; for instance, two animals for beef purposes, adapted to that particular purpose, and instead of two females, I would suggest four, and let the proposition be made with the understanding that we comply with this. We make a report to them that we will furnish four females and two males, providing any four other breeds of those mentioned by him are obtained. That would be my idea of making the report.

The Legislature also, recognizing the practical value of the proposed investigation, made liberal appropriation for a barn, suitable for the purpose of the experiment, and amply convenient arrangements have been made for twenty-four animals, besides four box stalls and five stalls for bulls.

The following is a list of the several animals of the different breeds which have already been secured, and it will be seen that the Station has been most fortunate in securing not only select representatives of the several breeds, but of the more noted strains and families of the severals breeds; and, what is of even equal value for the purpose of making this proposed test exhaustive and conclusive, we have secured the hearty coöperation, friendly advice and suggestions of those best fitted in the country to devise the means by which this test may be rendered most complete and satisfactory.

HOLSTEIN-FRIESIAN.

NAME.	Sire.	Dam.
Tolsma Artis (13103)	General Artis (2482)	Aaltje Tolsma 3d (1110).
Esel 2d (13966)	A. Daisy Netherland (3518)	Esel (2505).
Netherland Dowager 4th (11443)	Netherland Monk (4424)	Netherland Dowager (2632).
Copia 3d (12642)	Empire (588)	Copia (1067).
Aaggie Constance's Clothilde (9831), bull	Clothilde 4th's Imperial (1281)	Aaggie Constance (2629).
Alexander Hamilton, steer	Hamilton (686)	Sophie Veeman (472).
AYRSHIRE.		
Queen Duchess (9789)	Sir Hugh (2582)	Dutchess of Smithfield (4256)
Junietta Peerless (10273)	Peerless Douglass (4059)	Jenette Douglass (8094).
Manton Belle (9958)	Enoch (3757)	Manton Queen 5th (8052).
Miss Flow 5th (10148)	Bob Conley (3369)	Miss Flow 1st (6345).
Dynamite (4343), bull	Casino (3900)	Rosa (3143).
AMERICAN HOLDERNESS.		
Maggie 6th	Acme (76)	Maggie (33).
Nellie 6th	Acme (76)	Nellie 3d (119).
D. B. Hill, steer	Acme (76)	Louisa (26).
Grover Cleveland, steer	Acme (76)	Belle (78).
GUERNSEY.		
Rosette Ford (4067)	Colley's Lad (1372)	Musette Ford 2d (2641).
Oriole (4003)	Traveller (340)	Rose of Otranto (1020).
Cathay, steer	Prometheus (1488)	Grisel (2555).
Khaledan, steer	Prometheus (1488)	Rhodope (3397).
JERSEYS.		
Gilderbloom (54412)	Gilderoy, Jr. (16625)	Clover Bloom 2d (12736).
Countess Flavia (52047)	Flavius (13756)	Countess of Beaumont 2d.
Heifer	Deerfoot Stoker (20142)	Linklet (35946).
Bull		

It is hoped that representatives may be secured of several other of our prominent dairy breeds, notably the Short Horns, Devons and Brown Swiss, in order that this test may be as full and complete as is possible, since the additional expense of caring for these others would be but trifling.

While therefore there will be every opportunity during the progress of these investigations to carry forward all the work looking to the solution of the many questions pertaining to feeding, to the production and quality of milk for the several purposes of butter and cheese making, as heretofore, there will be the increased value which such investigations will have, when applied to the several breeds of dairy cattle now prominently before the country.

Of course it is not proposed that such important conclusions as it is hoped to draw from these investigations will be limited to the few animals of each breed which for convenience it is found best to begin with, for it is proposed to increase the herd gradually and broaden the work, until the accumulated data shall be such as to carry conviction to every one who shall carefully consider the results obtained.

During the past four years Doctor Goessmann, of the Massachusetts Agricultural Experiment Station, has been conducting a series of experiments to determine the cost of the production of milk from different cows and upon different rations.

He estimates that twenty per cent of the fertilizing value of the food is sold in the milk, and that eighty per cent may be saved by the adoption of proper methods for securing it. From the total cost of food he deducts eighty per cent of the value of its fertilizing constituents and thus arrives at the net cost of the food.

As an average for the four years, having the first year two cows, three the second, six the third and nine the fourth under experiment, he finds the variation in the cost of production of milk, comparing the least profitable cow upon the least economical food with the most profitable cow upon the most economical food to be as follows:

YEAR.	Number of cows.	Average quarts milk per day during experiment.	Variation in total cost of food per quart milk—cents.		Variation in net cost of food per quart of milk—cents.		Variation in ratio of total cost.		Variation in ratio of net cost.	
1885-86	2	11.89	.97	2.64	.50	1.64	100	272	100	3 28
1886-87	3	12.60	.85	2.76	.34	1.96	100	325	100	5 76
1887-88	6	11.14	1.01	4.74	.50	3.09	100	469	100	6 18
1888-89	9	10.09	1.30	5.48	.63	4.29	100	422	100	6 81
Average							100	372	100	5 51

It will be seen that, as an average of the four years trial, the total cost of milk produced from one cow in the herd was about three and three-quarter times as much as from another, and the net cost about five and one-half times as much from one cow as from another.

This then we may consider as the result due to the differences in cows and in food, and that the animals were above the average of our dairy cows is shown by the average milk product obtained.

But if we take the general variation of all the cows, we shall find upon the average that the variation in total and net cost of production of milk from all the cows, upon all foods fed, during the four years was as follows: Total cost, 100:192; net cost, 100:262.

This represents the results which may be secured even with good animals by attention to the economies of feeding; a difference of ninety-two per cent in total and 162 per cent in net cost of production of milk as the result alone of feeding; or by careful selection of animals adapted to the purpose of milk production, it is seen, even with so limited a number of animals as were under investigation, and by carefully selected rations a difference of 272 per cent in the total and 451 per cent in the net cost of production of milk.

What other large industry presents such a grand margin of possibilities?

The following table presents in a condensed summary the results given elsewhere in detail, which have thus far been secured with the several animals of different breeds which have been secured for an extended investigation.

Twelve of these have already been at the Station, upon an average of five and one half-months (October first), and while of course it is obviously too early to attempt anything in the nature of generalization, it is thought that a study of the data already secured may prove both of interest and value.

It will be obsered that, as a rule, the younger the animals the less food required to produce a given increase in weight as would naturally be expected; as also that their relative increase in weight decreases with their age, although as yet they are all growing, making satisfactory increase.

Steers.	NAME.	Age, April 1, days.	Number days at Station.	Weight when received, pounds.	Weight Oct. 1, pounds.	Total gain, pounds.	Per cent gain in weight.	Pounds gain per day.	Dry matter in food, pounds.	Dry food per day to 100 pounds, average weight.	Ratio.	Dry food to one pound, gain.	Ratio.
Guernsey	Khaledan	28	144	161	369	208	129	1.4	797.7	2.09	97	3.9	.54
Guernsey	Cathay	37	144	152	330	178	117	1.2	715.3	2.06	96	4.0	.56
Holstein-Friesian	Alex. Hamilton	62	180	184	528	344	187	1.9	1,377.6	2.15	100	4.0	.56
Am. Holderness	G. Cleveland	212	173	454	715	261	57	1.5	1,877.2	1.86	87	7.2	100
Am. Holderness	D. B. Hill	222	173	400	687	287	72	1.4	1,901.2	2.02	94	6.6	.92
Heifers.													
Holstein-Friesian	Copia, 3d	266	186	475	839	364	77	2.0	2,276.3	1.86	100	6.3	.65
Holstein-Friesian	Esel, 2d	283	186	634	871	237	37	1.3	2,296.4	1.64	88	9.7	100
Holstein-Friesian	Neth. Dowager	327	178	575	884	309	54	1.7	2,074.2	1.60	86	6.7	.69
Holstein-Friesian	Tolsma Artis	334	184	654	935	281	43	1.5	2,387.8	1.64	88	8.5	.88
Ayrshire	Junietta Peerless	221	151	301	522	221	74	1.5	1,408.2	2.27	98	6.4	.82
Ayrshire	Manton Belle	230	150	396	688	292	74	1.9	1,651.4	2.31	100	5.7	.73
Aryshire	Miss Flow, 5th	236	141	559	795	236	42	1.7	1,848.5	1.94	84	7.8	100
Aryshire	Queen Duchess	292	156	397	627	230	58	1.5	1,644.5	2.06	89	7.1	.91
Guernsey	Oriole	219	138	257	489	232	90	1.7	1,370.6	2.66	100	5.9	.66
Guernsey	Rosette Ford	326	146	481	681	200	42	1.4	1,776.6	2.10	98	8.9	100
Am. Holderness	Maggie, 6th	229	173	318	552	234	74	1.4	1,505.1	2.00	100	6.4	.91
Am. Holderness	Nellie, 6th	234	173	380	590	210	55	1.2	1,476.6	1.76	88	7.0	100
Jersey	Gilderbloom	360	76	479	586	107	22	1.4	844.5	2.09	....	7.9	.....

To still further condense the above results it will be seen that if we group the five steers, the four heifers of Holstein-Friesian and Ayrshires and two Guernsey and American Holderness heifers, we find an average as follows:

	Gain per day.	Pounds dry food for 100 lbs. weight.	Pounds dry food for 1 lb. gain.
Steers	1.48	2.04	5.14
Holstein-Friesians	1.63	1.69	7.80
Ayshires	1.65	2.15	6.75
Guernseys	1.55	2.38	7.40
American Holderness	1.30	1.88	6.70

It is to be remembered that the same ration in composition and quality was furnished the steers, and though a different ration was fed the heifers it was in composition practically the same to each, though differing in quantity.

It is interesting to observe also that there is very great fluctuation in the daily gain in weight of the several breeds alike, as will be seen by the following table, where the average daily gain in pounds of the several breeds are given for the different months:

	April.	May.	June.	July.	Aug.	Sept.	Oct.
Holstein-Friesian	1.78	2.42	1.49	.74	1.03	2.17	,63
Ayrshire	....	....	1.95	.74	1.06	1.84	1.20
Guernseys	....	....	1.77	1.02	1.26	1.48	.69
American Holderness	....	2.32	1.13	.89	1.08	1.80	.81
Jersey	....	....	....	....	1.35	1.17	.90

The effect of the warm weather of summer, annoyance of flies and the necessary change in feed later in the season is quite marked in the above.

EXPERIMENTS IN FEEDING CATTLE.

During five months trial with twelve growing heifer calves, the average gain in weight of which was 1.6 pounds daily, the average amount of dry matter consumed by them for each pound increase in weight was 8.4 pounds.

Since from two-thirds to three-fourths of the weight of the animal is water, the increase in water-free matter was, upon an average, about one-half a pound, so that it will be seen that, even with young animals, the growth of which is entirely satisfactory, the amount of food actually appropriated by them for growth over and above that needed to replace the waste of tissue, does not exceed six per cent of the dry matter of the food consumed by them.

In a series of experiments given in detail in the feeding trials, eight animals averaging 930 pounds in weight, four cows in milk, two heifers and two fattening steers; there was fed daily 175.3 pounds of dry matter, and there was found in the dung 68.1 pounds of dry matter; 12.23 pounds in the urine; 7.38 pounds in milk and 1.56 pounds in increase of weight during the experiment, a total of 89.3 pounds, thus leaving 86.0 pounds of dry matter in the food unaccounted for, which amount must have been consumed in supplying the other demands of the animals.

It has been estimated that the average man exhales as carbonic acid eight and one-half ounces of carbon daily or upon an average ninety-one and one-half per cent of the carbon in his digested food. The eight animals under experiment had an aggregate weight of 7,534 pounds; eight and one-half ounces of carbon is equivalent to 20.6 ounces of average carbohydrates as starch and sugar, those constituents of the food which probably are utilized for the production of animal heat and supplying muscular power. Supposing the demands of these animals for these purpose to be equal in proportion to their weight and that the average man should weigh 140 pounds, these eight cattle would have required 69.3 pounds which leaves but 16.7 pounds of the dry matter of the food unaccounted for.

If we consider the case of the four cows giving milk during the feeding experiment, we find the daily dry matter of their food to be 79.7 pounds, of which there was obtained 31.0 pounds in the dung, 5.62 pounds in the urine, 7.38 pounds in the milk, or a total of forty-four pounds, leaving 35.7 pounds to be accounted for; and as these cows weighed upon an average during the trial 3,798 pounds in the aggregate, they would have required upon the same estimate as before 34.8 pounds of dry matter of food for heat and work, an amount almost exactly equal to the quantity unaccounted for.

It will be seen therefore that even with growing animals not six per cent of the food consumed by them was retained, and in the case of the four cows giving milk only nine and a quarter per cent of the food was utilized in the production of milk, so that it is safe to estimate that fully ninety per cent upon an average of all the fertilizing constituents of the food consumed by these animals was again returned, and if properly preserved may be used to maintain the productive capacity of the soil.

MANURE PLATFORM.

It was for the purpose of securing this invaluable product of the farm, as also in connection with the extended feeding experiments with the several breeds of cattle and swine, to provide the means by which the amount and value of this material could be accurately determined that an appropriation was made by the Legislature for the purpose and there has been constructed a platform, described elsewhere in detail, for storing the manure from the several animals, with reservoirs beneath connected directly with the several stables and pens, by which arrangement it will appear to everyone, even upon the most casual inspection, that every needed facility exists for the preservation of every pound and pint of manure.

Few, I think, even of our most intelligent farmers fully appreciate the great importance of this matter.

In the case of eight animals the aggregate amount daily of dry matter in the dung was 53.28 pounds. This contained as the average of six of them 2.025 per cent of nitrogen, or 1.08 pounds which at nineteen cents per pound was worth 20.49 cents; 1.75 per cent of phosphoric acid, or .93 pounds, which at eight cents per pound was worth 7.46 cents; and .96 per cent of potash, or .51 pounds, which at six cents a pound was worth 3.07 cents; an aggregate for these three constituents of thirty-one cents, or three and seven-eights cents per day per cow.

There was also secured a daily aggregate of 108.7 pounds of urine from six of the animals, in which there was an average of 8.87 per cent of solids, 1.37 per cent of nitrogen, 1.337 per cent of potash, and a small quantity of phosphoric acid. This would give an aggregate average daily yield of 1.49 pounds of nitrogen worth 28.31 cents; 1.453 pounds of potash worth 8.72 cents, or aggregating daily thirty-seven cents or six and one-sixth cents for each animal.

This with the three and seven-eighths cents already obtained, makes ten and five-twelfths cents daily per animal. Now the market value of the daily rations fed these eight animals was exactly one dollar, or 14.27 cents per cow, from which it is seen that the fertilizing constituents in the dung and urine equalled seventy-three per cent of the market value of the food fed.

The point which appears to be so clearly established by the above experiment is one of such great importance to our farmers, that it will be the subject of more extended investigation in the future, for which we have excellent facilities, but at present it appears that the manure from fifty animals is worth yearly fully $1,900.

It is intended by means of a windmill to raise the liquid manure from the reservoirs below the manure platform into a tank from which a sprinkling cart may be loaded for the distribution of this material over the fields, and comparative tests will be made with several crops for the purpose of determining the relative value of this compared with the solid manure and other fertilizing material.

By means of a hose the contents of the tank may also be, from time to time, as necessity requires, distributed over the mass of manure upon the platform, and during such periods, when evaporation shall exceed the rainfall, a convenient hydrant will supply a stream of water sufficient to prevent the decomposition and fermentation of the pile from proceeding to an injurious extent.

If our farmers, who, to maintain or increase the fertility of their soils, are now accustomed annually to pay out large sums for commercial fertilizers may, as the result of these trials, learn that it is possible economically and practically to secure a supply of stable manure equal in value to sixty per cent of the market value of the several varieties of food fed to their animals, it would seem that this information alone would many times over repay the entire expense of their Experiment Station.

Certain it is that no farmer who visits the Station but may himself see the large quantity of valuable fertilizing material which, in nine cases out of ten, or ninety-nine out of 100, is wholly or mostly lost, saved by means not beyond his reach. It is an object lesson which does not fail to impress everyone who has recently visited the Experiment Station.

PIGGERY AND POULTRY-HOUSE.

It seemed that in connection with the contemplated investigations of the leading breeds of dairy cattle, there could be conducted conveniently similar investigations with the leading breeds of swine, for the purpose of determining their relative value in the production of pork; and the last Legislature made a liberal appropriation for the construction of a suitable piggery in which to conduct such experiments, as also for the construction of suitable houses in which to carry forward similar investigations with domestic fowls.

The piggery and the poultry-houses which have been constructed for these purposes will be found described in detail elsewhere.

In the reconstruction of the old cattle barn there was arranged a series of twenty-four pig pens, affording ample accommodation for keeping representatives of the principal breeds of swine, as also for experiments in feeding and fattening. Already choice animals of the Berkshires, Cheshire White and Duroc Red breeds have been secured, and it is intended at once to secure some others.

Attention is directed to the provision made for securing the manure from the pens and permitting the pens to be frequently and thoroughly cleaned. Yards have been so arranged as to allow out of door exercise to the pigs whenever it is desired.

A new poultry-house has also been built with every convenience, and already experiments are in progress for the purpose of ascertaining the actual and relative cost of producing both eggs and fattened poultry for the market.

CHEMICAL CONTROL OF FERTILIZERS.

It is in accord with the unanimous desire of the farmers of the State, as manifested by the numerous petitions, signed by hundreds of farmers in the several sections of the State, by many resolutions passed by farmers assembled at the various institutes, granges, farmers' clubs and agricultural societies; that there has been urged upon the Legislature the importance of some such legislation in this matter of commercial fertilizers, as has long been a means of protection to the farmers of every other State in which these products have come into general use.

It is worthy of note, that while such laws have existed in certain States for a quarter of a century, there is, so far as I know, not a single State which has ever abandoned the plan for the protection of the farmers, who in the purchase of these products, unlike other products sold in quantity, are wholly without the means of knowing anything as to their composition or value, and are not infrequently, even under the most careful supervision which is found practicable, subject to the most bare-faced frauds. This is evidenced in our own State where a fertilizer actually worth one dollar and fifty-two cents was sold at thirty dollars per ton; also, in Pennsylvania, according to a recent report from its station four fertilizers, worth respectively one dollar and twelve cents, eighty-seven cents, seventy-one cents, and six dollars and ninety-cents per ton, were sold at twenty dollars, eighteen dollars, twenty-one dollars and twenty dollars, respectively; so also in New Jersey, where two fertilizers for sale in that State had an actual value of only two dollars and eighty-nine cents, and two dollars and forty-two cents per ton, and sold at forty-five dollars and forty dollars per ton respectively.

Such illustrations could be multiplied, but it is unnecessary to give further evidence that our farmers who have need of such fertilizers to increase the products of their fields, are at present simply at the mercy of any dealer or manufacturer unscrupulous enough to thus defraud them. Nor is the protection which the supervision of the neighboring States extends sufficient for the protection of our people, since it is obvious that the above instances, of fraud detected in Pennsylvania and New Jersey, to which attention has already been directed, while preventing the sale of these products in those States, by no means prevents these same comparatively worthless brands being offered for sale under other names here in New York.

But, while the importance of guarding the people from fraud, against which they are necessarily unable to protect themselves, needs no further argument than the briefest statement of the case, it is probably true that the greatest benefit which would result from the work of such chemical control would be the increase of intelligence in relation to the use of these costly fertilizers, through the constant discussions concerning the presence and value of the leading constituents, nitrogen, potassium and phosphorus, which they are supposed to furnish as food to the growing crops.

At present these commercial fertilizers are generally known and spoken of as "phosphates," and many of our farmers would hardly recognize the term as misapplied, even if the sample offered them for sale contained no phosphoric acid whatever.

As a matter of fact, there is scarcely one in twenty of these so-called phosphates that does not contain a considerable amount of both potassium and nitrogen in one form or another, and in large measure its market value and crop-producing value as well is determined quite as much, or more, by these latter-named constituents than by the phosphorus it contains.

It is desirable therefore that our farmers shall come to appreciate, so far as agricultural science can indicate, the relative functions, need and importance of these fundamental elements of plant food, in order that they may more intelligently and economically apply them as their several necessities demand.

It is hoped therefore that at the next session of the Legislature there will be provided the means necessary for carrying forward this very important work. The means required are a suitably equipped laboratory and the chemists for performing the necessary analyses.

A DAIRY SCHOOL.

In view of the great importance of the dairy industry in our State, the wide range in the quantity as also in the quality of the manufactured products as shown by the intrinsic and market value of butter and cheese, these differences being due almost entirely to ignorance of the fundamental principles of milk, butter and cheese production, or a failure on the part of those engaged in this industry to appreciate the importance of a careful observance of these principles, it seems to me that it would be wise if there should be established a dairy school somewhat similar to those already established in several of the leading dairy sections of Europe. In this school, excluding military instruction, the classics and modern languages, there should be given instruction only in those technical branches directly relating to the science and practice of dairying.

Such a school should be located upon a good dairy farm, provided with cows of several breeds, with facilities for giving daily instruction by personal inspection and study, on the part of those in attendance, of the several technical operations of the dairy.

Such a school might be made nearly, if not quite, self-supporting, and would, I have no doubt, be welcomed by many young men and women who desire the specific instruction it would afford them, and would do much to render the $400,000,000 at present estimated as the capital invested in the dairy interests of the State, a source of greatly increased profit to our dairymen and farmers.

It was practically such a school which furnished the instruction that enabled Jesse Williams, thirty-eight years ago, to establish the first cheese factory in the State, the results of which are now manifest in every dairy section of the country; but even to-day there is no provision, should fifty, more or less, of our young men and women desire to secure the information which opened the way of success to this pioneer in the dairy industry of the State.

Recent inquiry has revealed the remarkable fact that in an art, one of the oldest in existence, and to-day in practice more extended than ever before in the history of the world, an art to which of late years and at present the attention of the inventive genius of the world and the researches of science have been directed to a remarkable degree, the demand for those who are in possession of the information discovered by science relating to the dairy industry, who are practically informed concerning the convenient technical devices of the inventors, far exceeds the present supply and the testimony from other States is to the same effect. Other professions and occupations appear fully supplied or overstocked with those fairly equipped for the work devolving upon them; but there yet remains room and remunerative employment for those competent to intelligently conduct the creameries, cheese factories and leading dairies of the State, and abundant room for an increased development of this industry in each of its branches.

BRANCH STATIONS.

During the past year the director has received very many letters of inquiry concerning the establishing of branch stations in several sections of the State.

I would again state the arguments which to me and others appear to justify the Legislature in making the necessary appropriation to carry out this plan.

In a State embracing so wide an extent of territory as does the Empire State, with its differences of soil and climate, and with such great diversity of agricultural interests, it must naturally appear that any experiment station, wherever located, is largely a local institution, and that its results however valuable and however clearly established are necessarily limited to the conditions obtaining at the locality where such experiments are being conducted.

It is true that the farm belonging to the Agricultural Experiment Station closely resembles in character of soil many thousands of farms within the State, it being mainly composed of clay, clay and gravelly clay loam, so that methods of culture here found best may be, almost without modification, applied to many other localities and the results here obtained may be confidently predicted in such similar localities.

But in view of the fact that this is a State institution and its benefits may justly be demanded by every agricultural interest of the State, it appears most desirable that in the near future there should be established in several different sections of the State branch Experiment Stations for the purpose of determining the results which are determined by differences of soil and climate. Such work could and would be conducted by intelligent farmers in their several sections, under the direction and supervision of the central Station, and in this way the useful work and influence of the Station could be widely distributed at a very slight additional expense.

It would seem best that such branch stations should be under the immediate supervision of local boards of control, who would themselves best select the one most intelligent and most in sympathy with the work to carry out the several experiments undertaken at these several branch stations, and who would thus feel a greater degree of personal responsibility for its thorough conduct.

The director will very gladly enter into correspondence with parties, and especially agricultural societies in the several sections of the State, through which some such a plan as is above outlined may be perfected and carried into execution.

It is said that there are to-day in the German Empire alone 184 agricultural experiment stations engaged in the promotion of every branch of agriculture. It would seem that as many as ten branch stations could find profitable employment in the solution of the numerous problems which are presenting themselves in the many and various fields of agricultural industry of our Empire State.

In accordance with a very earnest desire upon the part of the farmers of Suffolk county, the following bill was prepared and introduced into the last Legislature, but at too late a date to secure for it the careful consideration which such an important measure demanded.

It would appear that by some such means as is provided in this bill inestimable benefit to the varied agricultural interests of the State would accrue, and the work of the Station at Geneva be very greatly extended in its usefulness and with the greatest economy of expenditure.

AN ACT to establish branch agricultural experiment stations.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. For the purpose of promoting agriculture in its various branches by scientific investigation and experiment, provision is hereby made for the establishment of several branch agricultural experiment stations in this state, one of which shall be located in Suffolk county.

§ 2. The management of each of these several branch stations shall be committed to a board of control, composed of the director and the executive committee of the board of control of the state agricultural experiment station at Geneva, and of three other members residing in the vicinity of each branch station established. The three local members shall be appointed by the governor and confirmed by the senate, and they shall hold office for three years, or until their successors shall be appointed.

§ 3. The board of control organized in accordance with section two, shall annually elect a president from one of the three local members of the board, and shall appoint a secretary and a treasurer to hold such offices during the pleasure of the board. Two members representing the state agricultural experiment station at Geneva, with two of the three members of the board residing within the vicinity of the branch station shall constitute a quorum for the transaction of business.

§ 4. The boards of control of each of the several branch stations which may be established in accordance with section two of this act, shall locate and have general management of these several branch stations, and shall appoint a director to have the general oversight and management of the experiments and investigations which shall be necessary to accomplish the objects of such branch station under the general supervision of the director of the state agricultural experiment station at Geneva, and may employ other persons necessary to the carrying on of the work of these branch stations. Said board may acquire by lease or otherwise such real estate as may in their judgment be necessary for carrying on the work, and shall have the direction of the expenditure of all moneys appropriated and set apart to such branch station for the purpose aforesaid or otherwise received therefor. The board of control of each branch station which shall be established under this act shall annually make a full report to the director of the state agricultural experiment station at Geneva, which shall be embodied in his annual report. All property acquired by the said board shall belong to the state, and shall be disposed of and used only as authorized by law.

§ 5. The sum of twenty thousand dollars, or so much thereof as may be necessary for carrying out the provisions of this act, is hereby appropriated out of any money in the treasury not otherwise appropriated, which sum shall be paid to the treasurer of the board of control of the state agricultural experiment station at Geneva at such times and in such sums as the board of control of such station may require upon the order of the comptroller of the state of New York, who is hereby directed to draw his order for the same on the treasurer of the state.

§ 6. Every member of the board of control of the several branch stations which shall be established under the provisions of this act shall be paid his necessary traveling expenses as well as those incurred by him while in actual attendance upon the meetings of his board, but no member shall receive any other remuneration as such member.

§ 7. The boards of control of the several branch stations which may be established under this act shall make such rules and regulations as may from time to time become necessary to carry out the objects of said branch stations.

§ 8. This act shall take effect immediately.

It is believed that with the amount mentioned in the bill there could be established and maintained ten branch stations in as many different sections of the State, the scientific supervision and work being done by the central tation at Geneva.

CHANGES IN YIELD AND VALUE OF FARM CROPS IN NEW YORK.

In the following tables I have given the average acreage yield in bushels or pounds of our leading crops in the State for the several periods, 1862 to 1870, inclusive, 1871 to 1879, inclusive, and 1880 to 1887, inclusive; also the average market value of these crops for the same period:

Average acreage yield of leading crops.

YEARS.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Potatoes.	Hay.	Tobacco.
1862-70......................	30.20	14.93	15.15	30.32	22.33	19.77	103.1	2516.	918
1871-79......................	32.94	14.87	13.91	32.96	22.14	18.42	81.7	2404.4	919
1880-87......................	29.60	14.91	12.00	28.83	22.79	13.26	77.4	2225.	1383
Average market value of leading crops.									
1862-70......................	1.088	1.917	1.182	.652	1.240	.889	.63	15.211	.159
1871-79......................	.698	1.364	.810	.428	.856	.708	.552	13.46	.11
1880-87......................	.644	1.028	.718	.40	.746	.638	.52	12.495	.12

The following table shows the percentage changes which have taken place during these same periods in yield and market value:

Percentage changes in yield.

YEARS.	Corn.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Potatoes.	Hay.	Tobacco.
1862-70......................	100	100	100	100	100	100	100	100	100
1871-79......................	109	99	92	109	99	93	79	96	100
1880-87......................	98	100	79	95	102	67	75	88	151
Percentage changes in market value.									
1862-70......................	100	100	100	100	100	100	100	100	100
1871-79......................	64	71	69	66	69	80	88	89	69
1880-87......................	59	54	61	61	60	72	82	82	76

The above tables may be studied with interest as helping to explain the causes which have produced such general depression in the agricultural community.

It will be seen that, so far as crop production is concerned, there is little cause for alarm over diminished yield, for if we consider our five principal crops, corn, wheat, oats, potatoes and hay, the aggregate value of which is ninety-two per cent of the total value of our leading farm crops, we shall find that these five crops had fallen off in their average yield but 1.6 per cent in the second period over what it was in the first period and the average yield of the third period was within 8.8 per cent of what it was in the first; and this diminished yield is perhaps largely due to less careful cultivation which the low prices of farm products seemed in many cases to excuse if it did not justify.

But if we examine the table we shall see that the average market values have greatly depreciated, the five crops already mentioned having fallen, during the second period, in their average market value to 75.6 per cent of what it was in the first period, and during the last period having dropped still lower to an average of 67.6 per cent of what these crops sold for during the first period.

The average daily wages of farm laborers in thirty-six States for ten years have been as follows: Year 1879, wages 94 cents; year 1882, wages $1.07; year 1885, wages $1.05; year 1888, wages $1.06.

From the above it appears that the wages of farm laborers have remained nearly the same during the past ten years.

This remarkable shrinkage in the market values of agricultural products, while the cost of production remained practically constant, so far as the cost of farm labor goes, will alone account for the general complaint that farming has ceased to be profitable under existing conditions.

But in this connection it must not be forgotten that the productive power of manual labor upon the farm has been enormously increased during the past quarter of a century through the introduction upon the farm of labor-saving machinery of every description; and but for these appliances it would often appear impossible that the work of the farm at present could be accomplished.

While, therefore, the actual cost of manual labor remains practically the same, the results of such labor aided by all these mechanical appliances have been greatly increased, at the same time introducing a new item into the cost of production, viz., interest and wear and tear of all these implements of husbandry.

The following table gives in column first the average value of the leading farm crops of the State for the last twenty-six years according to the Report of the Department of Agriculture.

The second column gives the number of bushels or pounds of each crop which could have been bought for ten dollars, this being a convenient sum for comparison ; and there is given also the number of pounds of ash or mineral matter, of phosphoric acid, potash and nitrogen in these several quantities.

The estimate for milk is from the *American Agriculturist*, which gives 3.43 cents per quart as the average value to the producer of milk furnished New York city during the past twenty-one years:

	Average price.	Amount for ten dollars.	Pounds ash.	Pounds nitrogen.	Pounds potash.	Pounds phosphoric acid.
Corn	$0.816 per bushel.	12.25 bushels..	10.29	10.98	2.86	4.82
Wheat	1.452 "	6.87 " ..	8.24	8.57	2.58	3.80
Rye	.910 "	10.99 " ..	12.32	10.84	3.55	5.62
Oats	.497 "	20.12 " ..	21.23	12.36	3.31	4.52
Barley	.955 "	10.47 " ..	12.58	7.24	2.67	4.25
Buckwheat	.749 "	13.35 " ..	8.97	9.23	2.07	4.37
Potatoes	.569 "	17.58 " ..	43.26	3.38	26.35	7.92
Hay	13.769 per ton....	1,452 pounds..	83.49	24.46	22.79	4.34
Tobacco	.126 "	79.37 " ..	12.86	2.14	4.61	.47
Milk	.0343 per quart..	292 quarts...	4.40	4.40	1.07	1.88

The following table gives the market value of the several fertilizing constituents present in ten dollars worth of each of the leading crops :

	Nitrogen.	Potash.	Phosphoric acid.	Total.	Per cent of value of crop.
Corn	2.09	.17	.39	$2 65	26.5
Wheat	1.63	.16	.30	2 09	20.9
Rye	2.06	.21	.45	2 72	27.2
Oats	2.35	.20	.36	2 91	29.1
Barley	1.38	.16	.34	1 88	18.8
Buckwheat	1.75	.12	.35	2 22	22.2
Potatoes	.64	1.58	.64	2 86	28.6
Hay	4.65	1.37	.35	6 37	63.7
Tobacco	.40	.28	.04	72	7.2
Milk	.84	.06	.15	1 05	10.5

The practical lessons to be drawn from the above tables are very forcible and can not fail to carry conviction to anyone who will carefully consider them. It appears that upon an average the cereals contain an amount of nitrogen, phosphoric acid and potassium, which, at the current market price for these materials is worth almost exactly one-fourth the market value of the grain (24.1 per cent).

Potatoes contain somewhat more, 28.6 per cent of their average market value, while the hay crop contains nearly two-thirds (63.7 per cent) of its average market value. In other words, the farmer would have to pay for the potash, phosphoric acid and nitrogen in ten dollars worth of hay, six dollars and thirty-seven cents.

It will be seen also that milk contains of these fertilizing constituents only 10.5 per cent of its value, less than one-half the value contained in the cereals and less than one-sixth the value of these in the hay.

The practical conclusions are obvious:

First. Increase the area and production of grass and hay, and feed it.

Second. Increase and improve the several products of the dairy by careful selection and feeding of the animals, and by improvement in the methods of production of butter and cheese.

SORGHUM FOR FORAGE AND SYRUP.

Attention is directed to the reports of the assistant and superintendent of the farm of experiments made with many varieties of sorghum, some of which were quite new to this country, for the purpose of learning which would prove most valuable to our farmers for forage and for use as ensilage.

There was grown upon nine one-twentieth acre plats in hills, of one of the lightest varieties, an average crop of 20,933 pounds per acre, the minimum being 17,040 and the maximum 26,960 pounds. In drills this same variety gave an average on nine plats of 34,755 pounds, with a minimum of 24,440 and a maximum of 44,080 pounds per acre.

An average bundle of canes from these eighteen plats gave with a hand mill 66.07 per cent of their weight in juice, having a specific gravity of 1.068. This juice contained 10.95 per cent of sucrose and 3.78 per cent of glucose, although owing to the cold and cloudy weather the crop had not advanced upon an average much beyond the milk stage of the seed, when it was cut up for the silo.

Comparative feeding experiments will be made with the ensilage from this crop and from the crops of early and late cut corn.

It will be seen that the above crop gave an average per acre of 27,844 pounds of cane of which 27.4 per cent, upon an average, is leaves and tops, and 72.6 per cent stripped and topped cane, or 20,215 pounds, containing of juice which could be readily expressed by a hand mill 13,356 pounds, which juice contained 1,967 pounds of total sugars equal to at least 2,623 pounds or about 220 gallons of syrup.

There are at present several farmers in central and western counties who have for years been engaged in the growing of sorghum and the production of syrup therefrom, and, if their statements may be credited, this industry has proved to be by no means unprofitable to them. Certainly the results given above would appear to indicate that there might, by means of a central factory system established for working up the cane produced by a number of farmers, be a new and very profitable industry established, at least to the extent of furnishing an abundant supply of pure and wholesome syrup for home consumption.

But it will be seen that there were made thirteen analyses of the juices from seven varieties of sorghum which compare closely with the ten analyses of juices from seven varieties reported last year. For comparison the results are given below:

	Number of varieties.	Number of analyses.	Per cent cane sugar in juice.	Per cent glucose in juice.
1888	7	10	11.74	1.50
1889	7	13	12.00	1.56

From sorghum yielding a mill juice containing only ten per cent of cane sugar and 3.41 per cent of glucose, according to Bulletin No. 17, pages 9 and 10, Department of Agriculture, there was made in an experimental trial upon 219 tons of stripped and topped cane, 130½ pounds of sugar, and fifteen and one-half gallons of molasses per ton of cane.

In view, therefore, of the results obtained in the cultivation of sorghum these last two years, which seasons do not appear to have been in any way exceptionably favorable, I can not but repeat what was said in the report of last year: "Cane of this quality could be worked very profitably for sugar, but in this northerly latitude it will be found advisable to limit the manufacture to the production of syrup, which is already being produced in this section of the State of excellent quality, and commands a ready sale at good prices.

"It would seem that several farmers could combine in establishing a suitable factory, and thereby greatly lessen the cost of manufacture, improve the quality of the product and produce at good profit an abundant supply of excellent syrup."

INVESTIGATION OF THE GRASSES.

In connection with the dairy industry, there is no subject of greater importance than a study of our native and other grasses and at present this matter is receiving more than usual attention. In fact the hay crop, from every consideration, deserves especial attention, occupying, as it does, so large a portion, over one-half of our cultivated land (55.75 per cent), constituting nearly two-thirds of the weight (65.75 per cent), of all our principal farm crops, and removing, as it does, annually from our lands, over nine times as much potash as all the other crops combined; the hay crop containing 92.23 per cent of all the potash present in the marketed crops; there is found also in the hay crop, nearly three-fifths of all the phosphoric acid present in our leading farm crops, the hay crop containing 58.92 per cent of all the phosphoric acid present in leading crops of the State.

By means of the statistical reports of the Department of Agriculture during the last quarter of a century, it is found that the acreage in the six leading cereals grown in the State, was less during the last five years of the above period than it was during the first five years, (it having decreased 6.13 per cent), and that the acreage in hay had increased 38.43 per cent during the last five years, over what it was during the first five.

Again, while the average aggregate value of the cereals had decreased 47.52 per cent from the first period of five years as compared with the last five, the average aggregate value of the hay crop was practically unchanged, it having fallen off only 2.31 per cent. The acreage in hay during the first five years was nearly ten per cent less than that of the cereals, while during the last five years it has averaged nearly twenty-five per cent more than the acreage in cereals. Also the aggregate value of the hay crop of the State has relatively greatly increased during the past twenty-five years, for while during the first five years it was 29.2 per cent less than the aggregate value of the cereals, it averaged during the last five years 31.9 per cent more than the aggregate value of the cereal crop.

There has been during the twenty-five years a steady decline in the average acreage value not only of the cereal but also of the hay crop; but the decline in the value of hay has been far less than the average decline in that of the cereals; the latter have declined forty-four per cent, while the average acreage value of the hay crop has been but 29.44 per cent less during the last five years than it was during the first five of the quarter of a century under consideration.

It is also to be observed that this decline is not due to diminished production but to the general decline from the high prices prevailing during the war.

The above brief statistics are of the greatest significance as evidence that our farmers, with increasing intelligence, have come to appreciate the supreme importance of the grass crop, and there is no room to doubt that an increasing acreage in grass, with proper economy in its utilization upon the farm, will do more than anything else to render agriculture in our State more profitable in the future and increase rapidly the fertility of our lands. Indeed there are thousands of practical illustrations all going to prove that profitable agriculture and productive lands are closely connected with flocks and herds and the large areas for the production of the grass and hay made necessary for their maintenance; while they in turn more than furnish the material needed to sustain the fertility of those lands from which they derive their support.

The importance of this matter was early recognized by this Station, and for the purpose of systematic study and investigation of the grasses there were prepared a large number of plots upon which many different varieties have been grown from year to year, furnishing not only a valuable object lesson, which has been very generally studied by the farmers and others visiting the Station, but also affording opportunity for comparison of the valuable qualities of these many grasses.

During the past year there has been made great addition to the number of kinds grown, and at the present time there are in all 196 experimental plats covering an area of 1.3 acres, not including the separating paths; and in addition fifty-four field plats covering in all 3.7 acres.

These latter have been used in comparative tests for the purpose of learning the effects of the different fertilizing constituents upon the quantity and quality of hay produced, the results of which experiments are elsewhere detailed.

Upon the smaller plats, for the most part, are grown separate kinds of grass, and it is intended at an early date to enter upon an investigation as to their composition and feeding value at different periods of their development, while observations will be made as to their relative productiveness and ability to withstand the extremes of climate.

It is by no means improbable that as the result of such investigation there may be found among our native grasses many varieties which will well repay reintroduction upon lands from which, by nearly a century of cultivation, they have been driven out, having been replaced almost entirely by some few varieties now in almost general use among our farmers.

BULLETINS AND CORRESPONDENCE.

No better evidence is needed to show the increased interest which is being felt in all matters pertaining to the science of agriculture by our farmers than the very great increase which has taken place recently in the correspondence addressed to the Station and the constant applications pouring in daily for reports, Bulletins and information.

There have been published during the past season three Bulletins in which the following subjects have been discussed:

Bulletin No. 16.—*July*, 1889.

A study of the corn plant:
- *a.* Changes in the plant.
- *b.* Increase of dry matter.
- *c.* Sugars and starch.

[Lucerne or alfalfa:
  - *a.* Yield of, per acre.
  - *b.* Digestibility of the hay.

Bulletin No. 17.—*October*, 1889.

Cattle foods and feeding rations:
  1. Chemical composition of foods.
  2. Digestibility of foods.
  3. Amount of digestible matter in foods.
  4. Feeding rations.
  5. Rations fed by New York dairymen.

Bulletin No. 18.—*November*, 1889.

Testing of dairy breeds:
  Introductory.
  Breeds represented.
  Foods.
  Weights each month.
  Details of feeding.

For each of these Bulletins there has been a steadily increasing demand, and it is noteworthy that while many write to secure, so far as they may be able, all the Bulletins published, the number is far greater of those who prefer specific requests for certain Bulletins to which their attention has been directed through the agricultural press, thus showing that these Bulletins have happily met with specific wants for information among our farmers, who as never before appear to realize that science can aid them in their work.

An interesting and instructive illustration of the avidity with which our farmers accept new facts pertaining to their calling, or old truths presented in a novel way, was seen in connection with the exhibit made by the Station at the State fair at Albany and elsewhere. Along with a collection of fruits and vegetables, there was prepared and sent several series of glass bottles showing the actual amount of the several constituents present in several of the leading food materials in common use, and along with this the following circular giving a full explanation of this exhibit:

FOOD EXHIBIT. NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA, N. Y.

The exhibit of foods, illustrating their chemical composition, is intended as an object lesson for those farmers who will study it. Eight foods are selected: Corn at stage for ensilage, mangolds, milk, timothy hay, red clover hay, corn meal, wheat bran and cotton-seed meal. There are the same amounts of each of the foods, two pounds, three ounces (1,000 grams).

Please observe the difference in bulk or space occupied by the several foods.

Notice the large amount of water contained in green corn, mangolds and milk. Observe that milk contains less water than mangolds. It would hardly seem possible that milk should have less water than roots or green grass and corn, yet such is the case.

A half hour spent at this exhibit together with reading this description should enable one to understand what is meant by albuminoids, nitrogen-free extract, etc. Bearing these illustrations in mind, the terms used in Bulletins, agricultural papers and at farmers' institutes will be plain.

WHAT THE TERMS MEAN.

Water. — The amount of water in foods varies and while it is no different than water from other sources, yet its natural presence in the food, unmistakably renders the food more palatable, easily digested and readily assimilated.

Ash or Mineral Matter. — This consists of the phosphates, lime, postash, iron, magnesia, etc., and is used to build up the bony frame work of the body, etc.

Albuminoids. — These are the nitrogenous portions of food, also called protein. The dried white of an egg is almost pure albumen. Lean meats and casein in milk are good examples, also gluten — the gummy portion — from wheat. The albuminoids of food are used by the animal to build muscle — (lean meat) and for the casein of milk. For butter production albuminoids serve a most important purpose in foods for cows. Probably no mistake is more common in cattle-feeding than the giving of too small quantity of albuminoids to milch cows for greatest quantity of butter. In the exhibit of foods observe the amount of albuminoids in cotton-seed meal as compared with corn meal.

Nitrogen-free Extract consists of sugar, starch, gums, etc. Carbohydrates mean the same thing as nitrogen-free extract. Compare the difference in amount of nitrogen-free extract in corn meal and cotton-seed meal. Corn meal has the most of this starchy matter of any food generally used. The nitrogen-free extract or carbohydrates are used by the animal to produce muscular force, hea to keep the animal warm and for building up body fat.

Fat or Oil. — All are familiar with the nature of the oils from foods like cotton-seed oil, corn oil, linseed oil, etc. They serve the same purpose to the animal that the nitrogen-free extract does. One pound of oil will furnish nearly as much heat as two and one-half pounds of starch or carbohydrates.

Crude Fiber is the woody portion, and paper, sawdust, etc., are good illustrations. The nutritive value of fiber is small, but mechanically it serves a useful purpose in foods for animals that "chew the cud" or remasticate their food. Observe in the samples the large amount of fiber in hay and the small amount in corn meal.

The eight foods exhibited have about the following chemical composition, or in 100 pounds of each food there are as shown below:

	Water.	Ash.	Albuminoids.	Crude fibre.	Nitrogen-free extract.	Fat.
Maize forage	80.66	.99	1.54	6.10	10.07	.58
Mangolds	91.76	1.03	1.53	.86	4.67	.15
Milk	85.80	.70	4.43	....	*3.95	5.12
Timothy hay	15.35	4.16	6.59	26.88	44.33	2.69
Clover hay	15.35	5.50	12.05	25.99	37.63	3.48
Corn meal	17.08	1.30	8.90	1.74	67.16	2.82
Wheat bran	13.71	5.53	14.56	10.83	52.26	3.11
Cotton-seed meal	11.06	7.39	40.56	3.56	23.86	13.57

* Sugar.

Few realize the amount of fertilizing matter contained in one ton of the several foods shown in the exhibit. Are you aware, farmers, that when you sell one ton of hay you remove from your farm fertilizing matter that has cost you in commercial fertilizer as follows:

	Value fertilizing matter in 1 ton.
Timothy hay	$5 48
Red clover hay	8 20

Or when you buy one ton of corn meal or cotton-seed meal they have a fertilizing value as follows:

	Fertilizing Value.
One ton corn meal	$6 31
One ton cotton-seed meal	28 68

The difference in fertilizing constituents between corn meal and cotton-seed meal is very marked.

The following table gives the amount of nitrogen, phosphoric acid and potash in one ton of the eight foods:

	Nitrogen.	Phosphoric acid.	Potash.	Value.
Maize forage	4.9	1.2	5.7	$1 28
Mangolds	5.0	1.5	13.3	1 70
Milk	14.0	6.0	3.4	2 94
Timothy hay	21.0	5.0	27.5	5 48
Red clover hay	38.6	5.2	22.4	8 20
Corn meal	27.5	15.1	7.9	6 31
Wheat bran	47.3	51.7	17.0	13 10
Cotton-seed meal	130.4	55.6	37.8	28 68

The Bulletins published by the Station will be sent free to any farmer applying for them. A Bulletin will soon be published showing the chemical composition of foods, and their digestibility, also giving some rations calculated for milk production, and the rations fed by some of the leading dairymen of New York State.

While in this interesting exhibit there was not a fact which has not been presented over and over again to every intelligent farmer, the facts presented in this manner impressed themselves in a remarkable way upon all who inspected this exhibit, and beyond doubt the dry figures which are given hereafter to represent the percentage of carbohydrates, albuminoids, fats, fiber, ash and water which make up the several foods and products of the farm, will have a fuller meaning to those who were so fortunate as to have inspected this interesting exhibit.

It is interesting also to have observed that the number of those visiting the Station is rapidly increasing, hardly a day passing during which the work being done is not subjected to inspection upon the part of persons from different sections of the State and of the country.

Frequently granges and local agricultural societies in a body come to spend a day in looking over the farm and the stock, and during the season there have been frequent visits made by a committee of the State Grange, appointed for the purpose of watching and reporting the progress of the work going on at the Station.

Of course, this increasing interest in the experimental work in behalf of agriculture, is very gratifying as evidence that many of our farmers have come to appreciate the fact that what science has already accomplished in behalf of the other arts, it may also do for agriculture, so soon as its aid is accepted, its methods understood and its teachings adopted. Indeed, it has been said that "if to-day one should name the art which is nearest perfection he would select the one which has fellowshipped most closely with science."

Finally, I desire to suitably recognize the faithfulness and zeal with which those who have been associated with me in the work of the Station have performed their several duties. It is, of couse, impossible, even in the divisions which are made in the matter of the report, to do full justice to those whose names do not appear, and yet without whose coöperation and faithful labors the work could not have been accomplished.

It is hoped that as the value of the work of investigation here being done, and that for which preparations have been made shall be more fully appreciated, there will be granted increased facilities and a larger force to carry these investigations to speedy conclusion, for it must not be forgotten that an institution such as this is must, if its opportunities for good are recognized and improved, be in its very nature a growing institution, and therefore demands and should be provided with the necessary means for development.

It is obvious that the character of the work properly belonging to a Station which professes to pursue investigations in the various departments of agricultural science and give advice to those seeking information and guidance concerning their practice, is in pressing need of a corps of scientists in no respect inferior to those whose duties are limited to giving instruction in our colleges and schools of agriculture. Indeed, it would seem that there was the greater need that those whose advice is sought and whose suggestions are to be at once carried into practice should in every case be the best attainable authorities in their several departments of knowledge; in short, that there should be no "blind leaders of the blind," especially along a way so beset with difficulty so greatly demanding intelligent guidance.

GIFTS.

The following gifts have been made to the Station since the publication of the last report:

January 12. Of H. S. Bonnell, Waterloo, N. Y., one-half bushel of a new seedling potato.

January 17. Of H. A. March & Co., Fidalgo, Washington, two packets of American-grown cauliflower seed.

January 21. Of Dr. E. Lewis Sturtevant, South Framingham, Mass., one package of grape cuttings.

January 28. Of C. S. Goodwin, Ashfield, Mass., one package of lettuce seed.

Feburary 12. Of C. L. Hopkins, Acting Pomologist, Department of Agriculture, Washington, D. C., cions of Kelsey Japan plum.

February 25. Of James Vick, Rochester, N. Y., five packets of vegetable seeds.

February 26. Of Department of Agriculture, Washington, D. C., forty-eight packets of vegetable seeds.

March 4. Of C. L. Haven, Southport, N. Y., twelve ounces of Evergreen sweet corn.

March 4. Of John Rovana, Keokuk, Ia., two plant protectors.

March 5. Of Syracuse Chilled Plow Co., Syracuse, N. Y., one reversible sulky plow, one road scraper and one spring-tooth harrow.

March 6. Of J. C. Sufferns, Voorhies, Ill., one package each of Suffern's Champion and White Pearl corn.

March 6. Of K. Tamari, Imperial College of Agriculture and Forestry, Komaba, Tokio, Japan, a package of cions of various Japan fruits.

March 11. Of Ellwanger & Barry, Rochester, N. Y., four packages of grass seeds, comprising many varieties, and two grape vines.

March 11. Of Oscar H. Will, Bismarck, Dakota, one quart each of Pride of Dakota and White Flint corn.

March 14. Of R. Douglas & Sons, Waukegan, Ill., ten specimens of evergreen trees for Arboretum.

March 16. Of Northrup, Braslan & Goodwin Co., Minneapolis, Minn., ten packages of seed and a sample of Minnesota King corn.

March 16. Of United States Department of Agriculture, Washington, D. C., one quart each of four varieties of corn; four quarts each of two varieties of oats; one quart each of seven kinds of grass seed, and nine packets of other kinds of seed.

March 23. Of V. H. Hallock & Son, Queens, N. Y., four packets of vegetable seed.

March 27. Of J. H. Evans, Lewiston, Idaho Territory, two pear trees.

March 27. Of S. Frogner, Herman, Minn., two pounds of seedling potatoes.

March 28. Of Benjamin Buckman, Farmindale, Ill., a quantity of apple, pear and quince cions.

March 29. Of James J. H. Gregory, Marblehead, Mass., two tubers New Queen potato.

April 3. Of G. H. and J. H. Hale, South Glastonbury, Conn. twelve plants of Earhart raspberry.

April 3. Of M. H. Coleman, Geneva, N. Y., thirty-one plants of seedling raspberry.

April 3. Of Stayman & Black, Leavenworth, Kan., thirty strawberry and raspberry plants and one vine of No. 47 white grape.

April 5. Of I. W. Hoag, Pawling, N. Y., some plum cions.

April 5. Of the Gifford Manufacturing Co., Watertown, N. Y., one revolving ærated churn, No. 2.

April 5. Of J. T. Lovett, Little Silver, N. J., thirty-six strawberry plants.

April 6. Of T. C. Davenport, Philadelphia, Pa., one tuber each of two varieties of the potato.

April 6. Of J. F. Coffin, Westland, Ind., three vines of Mary's Favorite grape.

April 8. Of Wm. Parry, Parry, N. J., twenty-three varieties of large and small fruits.

April 9. Of Dorchester & Rose, Geneva, N. Y., one package of salsify seed.

April 9. Of A. P. Rose, Geneva, N. Y., a quantity of American Seedling persimmons.

April 11. Of S. C. DeCou, West Moorestown, N. J., thirty plants of the Felton strawberry.

April 11. Of N. Hallock, Creedmoor, N. Y., some tubers of Early Red potato.

April 12. Of G. A. Esenberger, Sr., 212 West Side Square, Bloomington, Ill., vines of fourteen varieties of the grape.

April 12. Of Chase Brothers Nursery Co., Rochester, N. Y., two trees of the "Bartseckle" pear.

April 12. Of O. H. Alexander, Charlotte, Vt., four packages of beans and some raspbery plants.

April 15. Of John Laws, Geneva, N. Y., one vine of the Jennie May grape.

April 15. Of Nauvoo Fruit Growers Association, Nauvoo, Ill., twelve plants of Lady Rusk strawberry.

April 15. Of F. R. Palmer & Son, Mansfield, Ohio, sixteen raspberry plants.

April 17. Of Ezra G. Smith, Manchester, N. Y., five raspberry plants.

April 18. Of Delano Moore, Presque Isle, Me., one package of turnip seed.

April 19. Of W. D. Barnes, Middlehope, N. Y., one vine each of two varieties of grapes.

April 19. Of Geo. W. Brooks, Bath, Me., two tubers each of four varieties of the potato.

April 19. Of John Burdett, Lasalle, N. Y., twenty-four strawberry plants.

April 22. Of Hugo Beyer, New London, Iowa, eight varieties of seed.

April 22. Of D. S. Marvin, Watertown, N. Y., two vines each of two varieties of the grape.

April 24. Of C. M. Winslow, Brandon, Vt., Ayrshire bull.

April 25. Of W. D. Gunn, Clintondale, N. Y., two vines of the Alice grape.

April 26. Of Z. H. Harris, 2 Norton street, Rochester, N. Y., one plant of the Sweet Damson plum and two plants of a raspberry seedling.

April 26. Of H. R. C. Watson, West Farms, N. Y., Ayrshire heifer.

April 27. Of A. J. Caywood & Son, Marlboro, N. Y., six Minniewaska blackberry plants.

April 26. Of Alfred Boyd, Toronto, Canada, a sample of "theff."

April 27. Of Green's Nursery Co., Rochester, N. Y., six plants of the Cloud strawberry.

April 27. Of D. H. Talbott, Sioux City, Iowa, a sample of Hulless Black barley.

April 27. Of F. E. McAllister, 22 Dey street, New York, N. Y., one package of Alfalfa or Lucerne.

April 29. Of Green Mont Nurseries, Dansville, N. Y., two peach trees.

April 29. Of G. D. Howe, North Hadley, Mass., a sample of Howe's Premium potato.

April 29. Of S. K. Kramer, Gahanna, Ohio, plants of Viola strawberry.

April 30. Of Sherman & Crouch, Sidney, N. Y., six plant protectors.

April 30. Of W. M. Benninger, Walnutport, Pa., sample of three varieties of the potato.

May 1. Of B. F. Smith, Lawrence, Kan., a quantity of strawberry plants.

May 1. Of A. S. Tubbs, Mexico, N. Y., Ayrshire heifer.

May 2. Of Obadiah Brown, Providence, R. I., Ayrshire heifer.

May 6. Of J. Hatt, Argentine, Mich., a sample of a new variety of the bean.

May 7. Of Frank Ford & Sons, Ravenna, Ohio, 110 strawberry and raspberry plants.

May 9. Of S. W. Hopkins, Geneva, N. Y., four packages of seeds.

May 11. Of L. S. Drew, Burlington, Vt., Ayrshire heifer.

May 14. Of A. N. Jones, Le Roy, N. Y., samples of new potatoes, corn and beans.

May 14. Of C. J. Baldridge, Kendaia, Seneca Co., N. Y., a sample of Baldridge Seedling potato.

May 16. Of N. B. Keeney & Son, Le Roy, N. Y., samples of four varieties each of peas and beans.

May 22. Of A. T. Cook, Clinton Hollow, N. Y., a sample package of Netted Giant muskmelon.

June 19. Of Crossman Bros., Rochester, N. Y., one quart each of Southern Fodder or Sheep Tooth, Red Cob, Ensilage and Stowell's Evergreen Sweet corn.

June 25. Of Daniel Batchelor, Utica, N. Y., one package each of Crested Dog's Tail and Yellow Oat grass, and one Kent plum tree.

July 27. Of L. W. Goodell, Dwight, Mass., four packages of pansy seed and eight packages of water lily seed,

December 12. Of the American Guernsey Cattle club, two Guernsey heifers and two Guernsey steers.

Of Holstein-Friesian Association, four heifers, one bull and one steer.

Of F. Bronson, Southport, Conn., one Jersey heifer.

Of Hon. E. Burnett, Southboro, Mass., one Jersey heifer.

Of Dr. H. M. Howe, Bristol, R. I., one Jersey heifer.

Of J. Montgomery Sears, Southboro, Mass., one Jersey bull.

In addition to the above the station has received gratuitously during the past year the following newspapers and periodicals, which gifts are hereby acknowledged:

NEWSPAPERS AND PERIODICALS PRESENTED TO THE STATION.

American Farmer and Horticulturist, Lakewood, Ohio.
American Florist, Chicago, Ill.
American Rural Home, Rochester, N. Y.
American Cultivator, Boston, Mass.
American Poultry Yard, Hartford, Conn.
Agricultural Epitomist, Indianapolis, Ind.
American Garden, New York, N. Y.
American Agriculturist, New York, N. Y.
American Grange Bulletin, Cincinnati, Ohio.
American Dairyman, New York, N. Y.
Country Gentleman, Albany, N. Y.
Cornucopia or Southern Horn of Plenty, Norfolk, Va.
Chicago Journal of Commerce, Chicago, Ill.
Chautauqua Farmer, Dunkirk, N. Y.
Colman's Rural World, St. Louis, Mo.
Courier and Farmer, Federalsburg, Md.
Canadian Entomologist, London, Canada.
Courier, Geneva, N. Y.
Canadian Horticulturist, Grimsby, Canada.
Every Week, Angelica, N. Y.
Farmers' Advocate, London, Canada.
Farm Journal, Philadelphia, Pa.
Farm and Implement News, Chicago, Ill.
Farm and Home, Springfield, Mass.
Farmers' Review, Chicago, Ill.
Farmers' Club Journal, Hornellsville, N. Y.
Fanciers' Journal, Philadelphia, Pa.
Florists' Exchange, New York, N. Y.
Farmers' Home, Dayton, Ohio.

Fruit and Grape Grower, Charlottesville, Va.
Geneva Gazette, Geneva, N. Y.
Holstein-Friesian Register, Brattleboro, Vt.
Home and Farm, Louisville, Ky.
Homestead, Des Moines, Iowa.
Husbandman, Elmira, N. Y.
Hoard's Dairyman, Fort Atkinson, Wis.
International Horticulturist, New York, N. Y.
Jersey Bulletin, Indianapolis, Ind.
Ladies' Home Companion, Philadelphia, Pa.
Maritime Agriculturist, Sackville, N. B.
Mirror and Farmer, Manchester, N. H.
Massachusetts Ploughman, Boston, Mass.
Maryland Farmer, Baltimore, Md.
National Farm and Fireside, Washington, D. C.
Nebraska Farmer, Lincoln, Neb.
National Economist, Washington, D. C.
National Stockman and Farmer, Pittsburg, Pa.
New England Farmer, Boston, Mass.
New England Homestead, Springfield, Mass.
New York Tribune, New York, N. Y. (Weekly edition.
Ornamental and Forest Tree Grower, Marinetta, Wis.
Orchard and Garden, Little Silver, N. J.
Orange County Farmer, Port Jervis, N. Y.
Ohio Farmer, Cleveland, Ohio.
Orange Judd Farmer, Chicago, Ill.
Practical Electricity, Boston, Mass.
Prairie Farmer, Chicago, Ill.
Poultry Monthly, Albany, N. Y.
Popular Gardening, Buffalo, N. Y.
Rural and Poultry World, Syracuse, N. Y.
Rural New Yorker, New York, N. Y.
Sanitary Volunteer, Concord, N. H.
Southern Cultivator, Atlanta, Ga.
Semi-Tropical Planter, San Diego, Cal.
Swine Breeders' Journal, Indianapolis, Ind.
Southern Planter, Richmond, Va.
Sugar Beet, Philadelphia, Pa.
Trade Journal, New York, N. Y.
Vick's Illustrated Monthly Magazine, Rochester, N. Y.

World, New York, N. Y. (Weekly edition.)
Weekly Press, Philadelphia, Pa.
Wool Journal, Chicago, Ill.
Western Resources, Lincoln, Neb.
Western Plowman, Moline, Illinois and St. Louis, Mo.

In addition to the above, the Station has regularly received, in exchange, the bulletins and reports from the several Experiment Stations and Agricultural Colleges of this country.

The accompanying plate gives a view of the Station buildings. It is taken from the northeast. It shows on the extreme left the windmill used for pumping liquid from the reservoirs beneath the manure platform which is directly north and between the windmill and the new barn, upon the left of which are the cattle yards. To the right of the new barn are the old barns, which have been roofed with iron, and the basements of which have been converted into piggeries, and upon the right hand are the horse barn and experiment barn, with the hot-house in front and the seven lysimeters in the foreground.

REPORT OF THE FIRST ASSISTANT.*

During the past year some preliminary work has been done on soils; poultry experiments have been continued; and a test of varieties of sorghum has been made.

This report contains record of the results thus far secured. More extended work on these experiments was not possible on account of the time given to the repairing of the old barn, etc., the building of a poultry-house, the bull stalls and piggery.

SOILS OF THE FARM.

In connection with proposed field experiments it was desirable that the composition of the soil of the farm should be known.

For convenience the principal fields were lettered, and samples taken from each. About fifty small vertical sections were taken and mixed for each sample; and when thoroughly air dried this sample was reduced by repeated quartering to a bulk small enough for convenient handling. With an implement devised for the purpose, it was not difficult to get an unbroken section. The samples of top soil were taken to a depth of ten inches and the subsoil samples from the next six inches below. No stones of more than about an inch in diameter were included in the samples. Noticeably uneven fields were divided into two or more parts, which were sampled separately.

A mechanical separation of each sample was made, using about 1,200 grams of soil. All pebbles larger than peas were first removed, and then the sample passed through sieves of respectively ten, twenty, thirty, forty and fifty meshes to the inch. Only that portion which passed through the fifty-mesh sieve was reserved for chemical analysis. In the top soils this portion was only 64.8 per cent, and in the subsoils 57.4 per cent of the soil.

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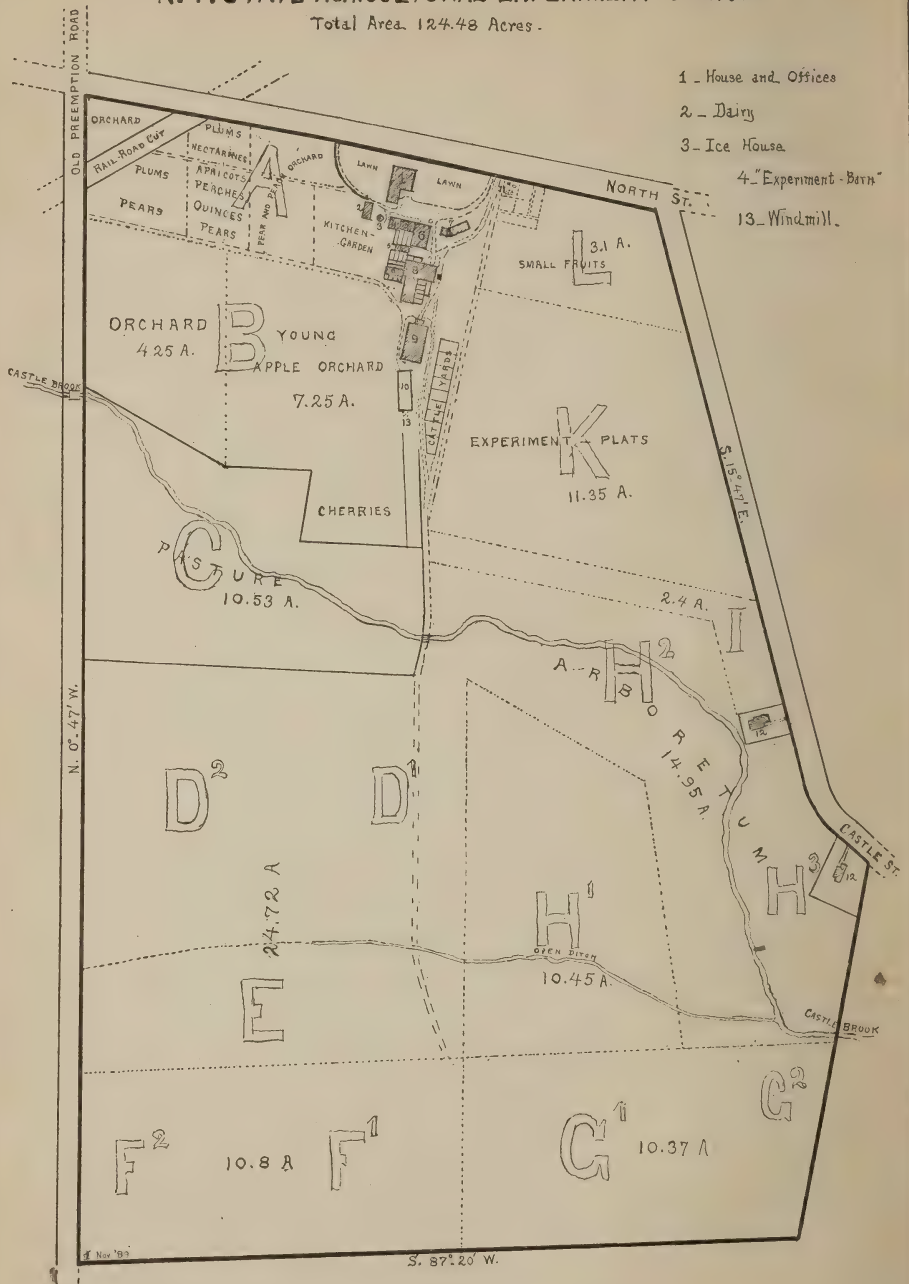
*William P. Wheeler.

N. Y. STATE AGRICULTURAL EXPERIMENT STATION

Total Area 124.48 Acres.



1 _ House and Offices
2 _ Dairy
3 _ Ice House
4 _ "Experiment - Barn"
13 _ Windmill.

5-5-5 _ Poultry Houses.
6 _ Horse Barn
7 _ Greenhouse
8 _ Old Barn.
9 _ Cattle Barn
10 _ Manure Platform
11 _ Thermometers and Lysimeters.
12 _ Tenement Houses.

The following map is used as a brief way of describing the location of the fields; and inasmuch as no map of the Station has ever been published, the locations of buildings, etc., are also indicated.

The result of the mechanical separation of soil is given in the following tables:

TOP-SOILS.	Per cent removed as pebbles.	Per cent removed by 10 mesh.	Per cent removed by 20 mesh.	Per cent removed by 30 mesh.	Per cent removed by 40 mesh.	Per cent removed by 50 mesh.
Field E	1.2	2.2	.8	1.6	1.6	7.4
D1	2.2	4.1	2.7	5.3	5.1	12.6
D2	3.9	2.8	1.9	4.9	4.2	12.9
H3	9.8	4.3	3.4	6.0	3.2	13.0
F1	6.3	3.8	3.3	4.0	2.7	12.6
F2	3.4	6.9	8.0	7.7	4.5	11.2
G1	5.2	5.0	9.0	10.0	3.3	10.7
G2	4.0	6.9	8.4	10.6	3.9	13.3
SUB-SOILS.						
Field E	4.7	2.9	.6	2.5	4.4	14.8
D1	1.8	4.1	3.4	8.0	6.1	11.2
D2	4.5	5.3	5.0	11.0	3.5	14.2
H3	12.1	7.9	8.4	8.1	4.2	9.4
F1	4.5	6.1	6.0	10.1	4.7	11.0
F2	1.6	5.6	10.0	8.7	4.6	13.6
G1	6.2	6.8	9.1	10.6	3.7	10.7
G2	6.3	8.4	10.0	8.3	3.8	12.7
Average of top-soils	4.5	4.5	4.7	6.3	3.6	11.7
Average of sub-soils	5.2	5.9	6.6	8.4	4.4	12.2

TOP-SOILS.	Total per ct. removed as pebbles.	Total per ct. removed by 10 mesh.	Total per ct. removed by 20 mesh.	Total per ct. removed by 30 mesh.	Total per ct. removed by 40 mesh.	Total per ct. removed by 50 mesh.
Field E	1.2	3.4	4.2	5.8	7.4	14.7
D1	2.2	6.3	8.9	14.2	19.3	31.9
D2	3.9	6.7	8.6	13.5	17.7	30.6
H3	9.8	14.1	17.5	23.5	26.7	39.8
F1	6.3	10.1	13.4	17.4	20.1	32.7
F2	3.4	10.2	18.2	25.9	30.4	41.6
G1	5.2	10.2	19.2	29.2	32.5	43.3
G2	4.0	10.9	19.2	29.9	33.7	47.0
SUB-SOILS.						
Field E	4.7	7.5	8.1	10.5	14.9	29.7
D1	1.8	5.9	9.3	17.4	23.5	34.7
D2	4.5	9.8	14.8	25.8	29.3	43.5
H3	12.1	20.0	28.3	36.4	40.7	50.1
F1	4.5	10.6	16.6	26.7	31.4	42.4
F2	1.7	7.3	17.3	25.9	30.5	44.1
G1	6.2	12.9	22.1	32.9	36.4	47.1
G2	6.3	14.7	24.7	33.0	36.8	49.5
Average of top-soils	4.5	9.0	13.6	19.9	23.5	35.2
Average of sub-soils	5.2	11.1	17.6	26.1	30.4	42.6

TOP-SOILS.	Finer than pebbles.	Finer than 10 mesh.	Finer than 20 mesh.	Finer than 30 mesh.	Finer than 40 mesh.	Finer than 50 mesh.
Field E	98.9	96.6	95.8	94.3	92.7	85.3
D^1	97.8	93.8	91.1	85.8	80.7	68.1
D^2	96.1	93.3	91.4	86.5	82.3	69.4
H^3	90.3	85.9	82.5	76.5	73.3	60.3
F^1	93.7	89.9	86.6	82.6	79.9	67.3
F^2	96.7	89.8	81.8	74.1	69.6	58.4
G^1	94.9	89.8	80.8	70.8	67.5	56.7
G^2	96.0	89.1	80.8	70.1	66.3	53.0
SUB-SOILS,						
Field E	95.4	92.5	91.9	89.5	85.1	70.3
D^1	98.2	94.1	90.7	82.7	76.5	65.3
D^2	95.5	90.2	85.2	74.2	70.7	56.5
H^3	87.9	80.	71.7	63.6	59.3	49.9
F^1	95.5	89.4	83.4	73.4	68.6	57.6
F^2	98.4	92.8	82.8	74.1	69.5	55.9
G^1	93.8	87.1	77.9	67.3	63.6	52.9
G	93.7	85.3	75.3	67.0	63.2	50.5
Average of top-soils	95.5	91.0	86.3	80.1	76.5	64.8
Average of sub-soils	94.8	88.9	82.4	74.0	69.6	57.4

Chemical analysis of several samples gave the following results:

	Top-soil, E.	Sub-soil, E.	Top-soil, D^1.	Sub-soil, D^1.	Top-soil, D^2.	Sub-soil, D^2.	Top-soil, F^1.	Average of top-soils.	Average of sub-soils.
Per cent moisture	1.24	1.40	1.23	1.04	1.28	1.48	....	1.25	1.31
Per cent organic matter	4.53	3.22	4.09	2.78	4.73	3.89	....	4.45	3.29
Per cent insoluble	80.09	78.17	81.83	80.09	79.69	77.10	78.29	79.97	78.45
Per cent soluble silica	.10	.15	.30	.23	(?)	.05	.34	.25	.14
Per cent iron and alumina ($Fe_2O_3 + Al_2O_3$)	10.39	13.02	9.34	10.95	10.12	12.41	10.59	10.11	12.13
Per cent lime (CaO)	.60	.65	.62	.96	.68	1.11	.70	.65	.91
Per cent magnesia (MgO)	1.02	.80	.85	1.26	1.94	1.31	1.04	1.21	1.12
Per cent soda (Na_2O)	.26	.34	.33	.36	.31	.36	.42	.33	.35
Per cent sulphuric acid (SO_3)	trace.	trace.	none.	none.	.005	trace.	trace.	trace.	trace.
Per cent potash (K_2O)	.95	1.35	.89	1.23	.98	1.34	1.04	.96	1.31
Per cent phosphoric acid (P_2O_5)	.115	.113	.093	.097	.134	.105	.117	.115	.105
Per cent ammonia (NH_3)	.215	.124	.255	.181	.271	.211	....	.247	.172
Per cent nitrogen	.178	.102	.210	.149	.223	.174	....	.204	.141
Per cent chlorine, carbonic acid, undetermined, etc	.71	.79	.43	.13	.16	.85	....	.43	.59

There are no great differences in the composition of the soils from separate fields. The subsoil is similiar to the top soil, but contains, however, less insoluble matter, more iron and alumina, lime, potash and soda, less organic matter by twenty-five per cent, less phosphoric acid and thirty per cent less nitrogen.

Although the soil contains a large per cent of potash, only a very small part of it exists in a soluble form. The soil from field E, which was the finest of any, and contained .95 per cent of potash, had only .03 (.028) per cent soluble in boiling water. The action of frost alone does not perceptibly increase the soluble portion; for some (300 grams) of this same soil, moistened with distilled water and frozen forty-seven times, still contained only .03 per cent soluble potash. Some experiments to determine the effect of adding gypsum, sulphate of soda, etc., to the soil have not been completed.

Some experiments with regard to the application of lime to muck soil, which contained (with 24.53 per cent moisture in air-dried sample,) 50.44 per cent organic matter, and 1.48 per cent of nitrogen, are also incomplete.

POULTRY FEEDING EXPERIMENTS.

The poultry work has been a continuation of the feeding experiments of 1888.

In order to observe the effect of rations more or less nitrogenous during the laying season, two pens of pullets were fed; a larger number of fowls being used and the rations less widely contrasted than in previous experiments. There were at first sixteen fowls in each pen, but during the latter five months there were thirteen. The number in each pen was kept the same, and the fowls comparable as to age and breed. The pens (Nos. 6 and 7), each originally contained four Light Brahmas, two W. Plymouth Rocks, three S. Plymouth Rocks, one Buff Cochin, four W. C. B. Polish and two S. C. W. Leghorns.

Pen 6 was fed a "mixture" (consisting, by measure, three parts of wheat bran, four of linseed meal and six of ground oats), corn on cob, oats and meat scraps, with very little fresh grass. Pen 7 was fed corn meal, oats, corn on cob and meat scraps, with very little fresh grass.

The composition of the food used was as follows : *

	Mixture.	Indian corn.	Oats.	Meat scraps.	Corn meal.
Per cent moisture	8.61	11.63	13.51	5.18	10.55
Per cent ash	4.60	1.23	2.66	5.95	1.49
Per cent albuminoids	25.47	10.99	11.62	44.14	12.58
Per cent fiber	10.02	1.19	11.81	5.03	2.36
Per cent nitrogen-free extract	45.75	71.07	54.28	....	68.26
Per cent fat	5.55	3.89	5.29	39.77	4.76

The per cent of moisture in the mixture varied considerably (from 13.24 to 8.61), but the composition is given with 8.61 per cent, in which condition it was during most of the time.

Although the fowls in each pen were fed only the kinds of food assigned them, they were allowed to select the amount and proportion, and thus to a certain extent make their own rations. The conditions were more normal than in the similar experiment last year, but there was much less contrast between the rations in the proportion of albuminoids to carbohydrates.

An accurate account was kept of the weight of the different constituents in the food consumed, the gain or loss in weight, and the product of eggs, etc. The results, calculated to the average for one fowl, for the different periods of the experiment, are given in the following tabulated form. The ratio of albuminoids to carbohydrates here given is the simple proportion between these constituents. No account is taken of the digestibility, and the weight of the fat is not multiplied. In column A of the table is found the weight of water-free food which was required to produce one ounce of egg entire, without regard to the gain or loss in weight of the fowls. Column B gives the weight of water-free food consumed for every ounce of egg free from shell produced, the gain in weight being added or the loss of weight subtracted from the egg product exclusive of shell.

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* These analyses of the poultry foods were made by Mr. Whalen.

PERIOD.	Number of days.	Average weight food consumed per day.	Average weight water-free food.	Ratio of albuminoids to carbohydrates.	Average gain for whole period.	Per cent gain.	Average weight eggs.	Average number eggs.	AVERAGE WEIGHT EGGS.		AVERAGE NUMBER EGGS.		A.—Average number ounces water-free food to one ounce eggs.	B.
									Brown shell.	White shell.	Brown shell.	White shell.		
PEN NO. 6.		Ounces.	Ounces.		Ounces.		Ounces.		Ounces.	Ounces.	Ounces.	Ounces.		Ounces.
January 10 to March 9..	58	4.272	3.768	1:4.2	+23.00	+34.08	8.02	4.19	7.95	8.13	3.90	4.67	27.25	7.25
March 9 to April 9	31	4.462	3.957	1:3.7	— 1.00	— 1.10	29.78	15.18	33.05	24.33	16.50	13.00	4.12	4.76
April 9 to May 10........	31	3.813	3.361	1:4.4	— 7.44	— 8.31	33.25	16.18	35.30	29.83	16.20	16.17	3.13	4.63
May 10 to June 10.......	31	2.383	2.126	1:4.8	— 7.07	— 8.88	19.38	9.50	23.78	13.50	11.13	7.33	3.40	6.35
June 10 to July 10.......	30	2.593	2.202	1:4.1	— 7.08	— 9.45	14.87	7.15	17.25	11.05	8.00	5.80	4.44	10.49
July 10 to August 10....	31	2.533	2.244	1:4.2	+ .23	+ .34	6.37	3.00	8.59	2.80	4.00	1.40	10.92	12.08
August 10 to Sept. 10....	31	2.695	2.389	1:4.3	+ 3.61	+ 5.31	3.92	1.77	5.41	1.55	2.38	.80	18.89	10.38
September 10 to Oct. 10.	30	3.441	3.058	1:4.0	+ 3.85	+ 5.36	5.10	2.46	6.25	3.25	2.88	1.80	17.99	10.87
October 10 to Nov. 9.....	30	3.364	2.993	......	+ 3.23	+ 4.28	....	......	....	....	....	....	....	27.80
Total average	....	3.383	2.987	1:4.2	....	......	....	......	....	....	....	....	7.51	10.19
Total	303	....	....	......	....	......	120.69	59.43	137.58	94.44	64.99	50.97	....	....
PEN NO. 7.														
January 10 to March 9..	58	4.673	4.131	1:5.3	+26.00	+36.05	19.45	10.31	18.55	20.96	9.70	11.33	12.32	5.51
March 9 to April 9	31	4.930	4.431	1:4.7	— 3.69	— 3.77	25.83	12.44	23.05	30.46	10.60	15.50	5.32	7.02
April 9 to May 10.......	31	3.825	3.370	1:5.6	— 6.44	— 6.85	30.98	15.12	29.15	34.04	13.70	17.50	3.37	4.87
May 10 to June 10.......	31	3.249	2.748	1:5.8	— 8.43	— 9.93	22.45	10.79	23.88	20.54	10.75	10.83	3.79	7.32

PERIOD.	Number of days.	Average weight food consumed per day.	Average weight water-free food.	Ratio of albuminoids to carbohydrates.	Average gain for whole period.	Per cent gain.	Average weight eggs.	Average number eggs.	AVERAGE WEIGHT EGGS.		AVERAGE NUMBER EGGS.		A.—Average number ounces water-free food to one ounce eggs.	B.
									Brown shell.	White shell.	Brown shell.	White shell.		
PEN No. 7—(*Continued*).		Ounces.	Ounces.		Ounces.		Ounces.		Ounces.	Ounces.	Ounces.	Ounces.		Ounces.
June 10 to July 10.......	30	2.867	2.524	1:6.2	— 5.46	— 6.92	14.00	6.77	13.66	14.55	6.38	7.40	5.41	10.61
July 10 to August 10....	31	2.516	2.220	1:6.2	— 5.70	— 8.59	8.98	4.38	9.63	7.95	4.63	4.00	7.66	28.91
August 10 to Sept. 10....	31	2.642	2.331	1:6.2	+ .92	+ 1.36	.92	.46	....	2.40	....	1.20	78.54	41.28
September 10 to Oct. 10.	30	3.251	2.870	1:6.3	+ 7.54	+10.97	2.48	1.15	2.06	3.15	.88	1.60	34.72	8.81
October 10 to Nov. 9.....	30	3.941	3.483	......	+11.77	+15.44	....	......	....	....	....	....	....	8.88
Total average	....	3.657	3.224	1:5.7	....	......	....	......	....	....	....	....	7.81	12.87
Total...	303	....	....	......	....	......	125.09	61.42	119.98	134.05	56.64	69.36	....	....

For the first period of two months (during only the latter part of which the fowls were laying), the weight of water-free food required for one ounce gain in weight was, for Pen 6, 9.5 ounces, and for Pen 7, 9.2 ounces. During the three last months, when very few eggs were obtained, there was also a gain in weight, although the fowls were molting. For this period there were consumed an average of 23.9 ounces of water-free food for a gain of one ounce in Pen 6, and in Pen 7, an average of 11.2 ounces. There was a continued loss of weight in both pens during the laying season. Pen 6, with the more nitrogenous ration, gained less, and more slowly in weight, and also lost less, and more slowly than No. 7. The total average loss of weight in No. 6 was sixty-six per cent of the total average gain; and in No. 7 the total average loss was sixty-four per cent of the total gain. The fowls in No. 6 averaged at the end of the ten months about eleven ounces heavier than at the beginning of the experiment, and those in No. 7 about sixteen ounces.

The average weight of eggs laid, per fowl, in No. 6, was 120.7 ounces, and 125.1 ounces in No. 7; a very slight balance in favor of the less nitrogenous ration. There was a much greater difference in the yield of eggs from the different classes of fowls as indicated by the color of the shell. There was an average product of 137.6 ounces of brown-shell eggs per fowl from No. 6, and 120 ounces from No. 7. Of the white-shell eggs, however, there were 94.4 ounces from No. 6, to 134.1 ounces from No. 7. The larger breeds did somewhat better with the more nitrogenous ration, and the smaller breeds considerably better with the less nitrogenous. The average weight per egg was the same for each pen, 2.03 ounces. The brown-shell eggs averaged 2.12 ounces in each pen, and the white-shell eggs 1.85 ounces in Pen 6, and 1.93 ounces for Pen 7.

In June, when the composition of the rations had been the nearest alike, analyses were made of ten white-shell and ten brown-shell from each pen. The analyses (representing the composition of the entire edible portion of the egg) showed very little practical difference. The average results were as follows:

	Twenty eggs, average No. 6.	Twenty eggs, average No. 7.	Twenty eggs, average brown-shell.	Twenty eggs, average white-shell.
Per cent water	74.57	74.72	74.56	74.72
Per cent albuminoids	12.15	12.69	12.59	12.25
Per cent fat	10.21	9.91	9.87	10.25
Per cent ash	.91	.92	.90	.92
Per cent total solids	25.43	25.28	25.44	25.28

Analyses were made in 1888, of eggs from fowls obliged to subsist on rations widely different; and greater difference in the composition was found, most notably in the per cent of ash.

During February, the fowls in No. 7 (fed with corn meal), after they had become very fat and commenced laying, began picking the feathers and flesh from each other to such an extent that one was killed, and two more so badly hurt that it was necessary to keep them for a long time in a separate pen. This habit disappeared after they had been fed meat scraps for a time. The lack of fresh vegetable food at this time could hardly alone have been the cause, for Pen 6 was not so affected. (In the experiments of 1888, the fowls fed excessively with corn meal were the only ones diseased, and they had a liberal supply of raw apples and fresh grass.) Later on, the fowls in Pen 7 began eating eggs. Those first discovered were removed; but after it was observed that a majority had acquired the habit, they were left together and all possible precautions taken to secure the eggs. When, however, one was found broken, it was added to the record with the average weight for eggs of its color. In view of these facts, it is possible that the number of eggs accredited to No. 7 may be somewhat less than the actual yield; but if so, this would affect the result only slightly in degree and not in kind.

The weight of manure collected from the roost platforms, calculated to dry manure, was as an average of one fowl in Pen 6 17.9 ounces per month, at the rate of 13.4 pounds a year, equivalent to 33.3 pounds fresh manure, as the average per cent of moisture was 59.7. In Pen 7 the average was 17.3 ounces per month, or 13 pounds a year, equivalent to 29 pounds fresh manure, the average per cent of moisture being 55.3. The analyses of average samples from these pens resulted as follows:

	PEN 6.		PEN 7.	
	Dry manure. Per cent.	Fresh manure. Per cent.	Dry manure. Per cent.	Fresh manure. Per cent.
Ammonia (NH_3)	2.42	.98	1.78	.80
Phosphoric acid (P_2O_5)	2.28	.92	1.61	.72
Potash (K_2O)	.79	.32	.55	.25

The average amount of organic matter was about 40 per cent in the dry manure, equal to 17 per cent in the fresh. There was a loss of ammonia in drying equal to about 42.6 per cent, so that there would be obtained from the manure, if used fresh, 1.71 per cent and 1.39 per cent instead of .98 and .80 per cent as calculated back from the analyses of the dry samples. Analysis of an average sample of fresh manure from these pens gave nitrogen equivalent to 1.55 per cent of ammonia. Where the manure is not used when fresh, it is better to mix it with dry earth, muck or plaster. Analyses of samples of air-dried manure from experiment pens of 1888 gave the following results, which show the same relation as exists between the samples above mentioned:

	From fowls fed a nitrogenous ration.	From fowls fed a carbonaceous ration.
Per cent ammonia (NH_3)	2.22	1.86
Per cent phosphoric acid (P_2O_5)	2.21	1.92
Per cent potash (K_2O)	1.11	1.01
Per cent moisture	7.44	7.13
Per cent organic matter	41.91	34.71

The commercial value of these air-dried manures would be $13.31 and $11.35 per ton. The value of the average product of manure per fowl from Pen 6 was about fourteen cents a year, and from Pen 7 about ten cents; the fresh manure from Pen 6 being worth $8.35 and from Pen 7 $6.73 per ton.

Two pens of fowls (twelve in each) were fed for fattening. One (No. 5) contained cockerels and the other (No. 8) capons. The full value of the experiment as a comparison between the pens was destroyed by the fact that through delay in obtaining instruments the operation of caponizing was postponed too long for the best results, and, also, several "slips" were included in the pen of capons, which was not known until the fowls were killed. The results are of value, however, in connection with those from the pens of laying fowls. Both pens gained in weight during the first two months, and during the third month Pen 8 gained but little, while Pen 5 lost in weight. Both continually lost weight after the third month, although the amount of food consumed was not less. The fowls were light Brahmas, Plymouth Rocks and buff Cochins, and they were fed a mixture of linseed meal, bran and ground oats; also, corn meal, oats, corn on the cob and meat scraps, the average daily feed per fowl being:

	Total food consumed.	Water-free food.	Ratio of albuminoids to carbohydrates.	Average gain for period.	Per cent of gain.
	Ounces.	Ounces.		Ounces.	
PEN 5.					
January 10 to March 9	5.638	4.962	1:4.6	23.41	23.26
March 9 to April 9	4.828	4.268	1:4.4	2.00	1.61
PEN 8.					
January 10 to March 9	5.723	5.035	1:4.5	28.08	28.20
March 9 to April 9	5.248	4.648	1:4.5	2.41	1.89

The fowls were allowed, to a certain extent, to select their own rations, being given all they would eat of the different foods. The fowls of No. 8 were in marked contrast to those of No. 5, as they were quiet, not quarrelsome, and always were in better "condition." The average weight of food consumed by No. 8 was greater, the gain in weight was greater, and the amount of water-free food for one ounce gain in weight was less, being 10.4 ounces for No. 8 and 12.3 ounces for No. 5, during the two months. The average weight of water-free food required by the twenty-four cockerels and capons for one ounce gain was 11.35 ounces, and for the thirty-two pullets during the same period 9.36 ounces.

The manure collected from the roost-platform of Pen 5 was at the average rate of 42.8 pounds a year per fowl, and contained 63.9 per cent moisture; and from Pen 8 was at the rate of 43.6 pounds a year, containing 65 per cent moisture. The manure from the fattening fowls was more valuable than from those which were laying, mostly from the larger content of nitrogen. The manure from Pen 8 analyzed as follows:

	Dry manure.	Fresh manure.
Per cent ammonia (NH_3)	4.33	1.51
Per cent phosphoric acid (P_2O_5)	2.66	.93
Per cent potash (K_2O)	1.02	.36

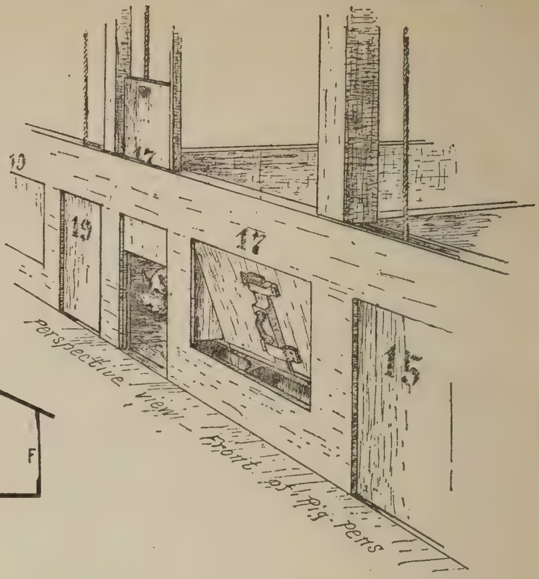
If this sample lost the same amount of ammonia in drying as did the others (42.6 per cent), then instead of 1.51 per cent of ammonia in the fresh manure there would be 2.63 per cent. The commercial value of the fresh manure would be $11.91 per ton, and the average value per fowl at the rate of twenty-six cents a year.

During one period of the experiments of 1888, the following result was obtained from a few fowls:

	Ratio of ash in feed to total water-free food.	Average per cent of non-volatile ash in egg.	Average per cent of shell to fresh egg.
Pen No. 3	1:27.0	1.45	10.78
Pen No. 4	1:51.1	.74	10.86

"The amount of ash in the feed of No. 4 and the per cent of ash in the eggs were less than for No. 3. Yet, although the number of eggs was more than three times as great as from No. 3, the per cent of shell was practically the same (slightly higher). The carbonate of lime in the shells of eggs from Pen 4 (ninety per cent $CaCO_3$ in the shell) was 206.1 grammes average per fowl. The amount of lime, calculated to carbonate of lime, in the ash of the feed was, during the same time, only 11.3 grammes per fowl. It would appear from this result that the source from which the fowls obtained material for the egg shell was independent of that which furnished the ash constituents of the egg itself." In connection with this result similar lots of fowls, fed the same grain and vegetable ration, were given — those of one pen all the ground oyster shells they would eat, and of the other all the ground bone. Partial analyses of the dried shells and of the ash of the egg were made, after the feeding had been continued for a few months. The greater amount of phosphoric acid in the ground bone did not appear to make much difference in the com-

POULTRY HOUSE AND PIG PENS



19
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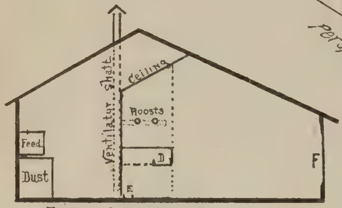
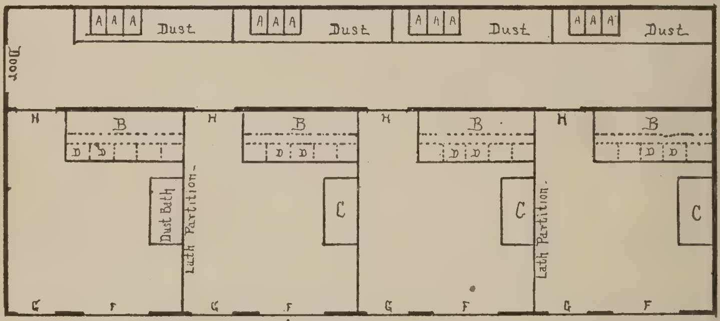
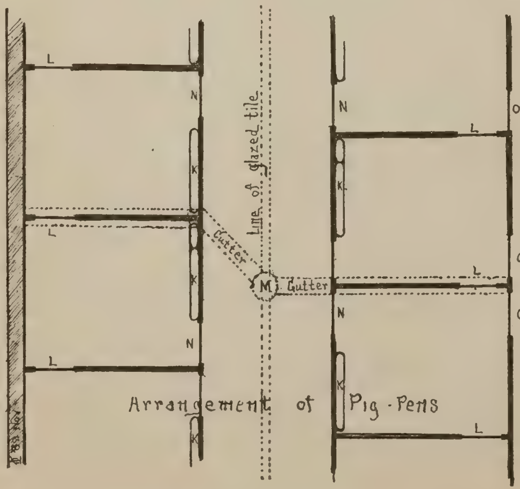
perspective view - Front of Pig pens



Poultry House, Elevation



Ground Plan of Poultry House



A, A, - Feed Boxes

B, B, - Roost Platforms

C, C, - Dust Baths

D, D, - Nests

E - Feeding Trough

F, F, - Windows,

G, G - Doors opening into yards

H, H, - Doors - (Wire mesh)

K, K, - Troughs

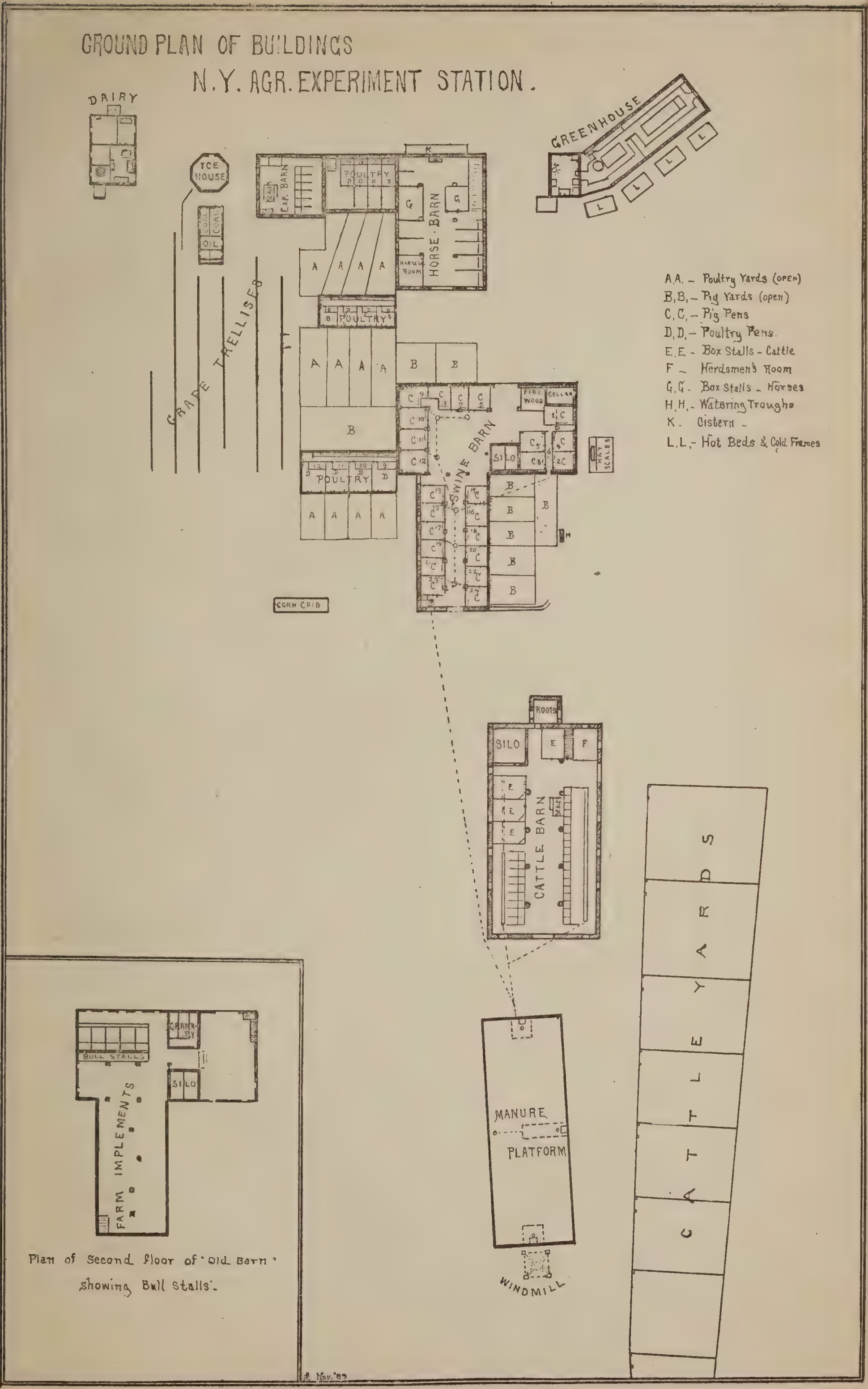
L, L, - Doors connecting pens

M - Trap

N, N, Doors opening into passage way

O, O - Doors opening into yards.

GROUND PLAN OF BUILDINGS
N.Y. AGR. EXPERIMENT STATION.



A.A. – Poultry Yards (open)
B,B, – Pig Yards (open)
C, C, – Pig Pens
D, D, – Poultry Pens.
E. E. – Box Stalls – Cattle
F – Herdsmen's Room
G, G. – Box Stalls – Horses
H, H, – Watering Troughs
K. – Cistern –
L. L, – Hot Beds & Cold Frames

Plan of Second floor of "Old Barn" showing Bull stalls.

position of the egg shell, although the shells from the pen fed bone always contained a slightly higher per cent of phosphoric acid. The eggs were both brown and white shell, thirty-two eggs being used from Pen 1 in which oyster shells were fed, and forty-one eggs from Pen 2 which had ground bone. More eggs were laid by those fowls which had ground bone. The average of the analyses were:

	PEN 1.	PEN 2.
	Per cent phosphoric acid (P_2O_5)	Per cent phosphoric acid (P_2O_5)
Ash of yolk	59.41	56.61
Ash of white	3.24	3 33
Dried shells	.28	.44

POULTRY-HOUSE, BULL STALLS AND PIGGERY.

During the year a new poultry-house has been built, similar to the smaller one built the year before, with pens arranged conveniently for feeding experiments. The building is forty-two feet long east and west by eighteen feet north and south; six feet high on the north side, five feet high on the south, and ten feet at the peak. The four pens, each twelve feet by ten and one half feet, are on the south side, and dust bins take two feet from the north side, leaving a passage-way four feet wide. From this passage, wire-net doors, six and one-half feet by two and one-half, open into the pens, and a lath door, four feet wide and two feet high, hinged at the top, swings under the roost platform far enough to allow food to be placed in the shallow food trough on the floor, which is four feet long, six inches wide and two inches deep. Separating the pens, are lath partitions, and on three sides of the roosting place, from the floor of the nests, which are below the platform, are tight partitions reaching to the tight ceiling above. Just above the dust bins, on the north side, are feed boxes of three compartments each. Two ventilating shafts, three by twelve inches inside, extend through the roof to within six inches of the floor. There are four windows on the south side, one in each pen, four feet wide by three feet high, one foot from the floor. A box two feet by four feet and six inches deep, containing a dust bath, is on the floor of each pen. The roof is covered with roofing paper, a thickness of "rope-roofing" over a coating of cheaper paper, and painted two coats. The accompanying drawing gives a general plan of the building.

The ground floor of the old cattle barn, underneath the whole extent of which was a pool of liquid manure and mud, has been torn out and rebuilt into a series of pig pens. The stone wall separating this floor from the basement of the main part of the old barn was removed. Part of this basement, which has been a store-room for rubbish of all sorts, was also filled with pig pens, and the dilapidated stone wall without windows, on the west end, was replaced by a low wall and wooden siding, in which are four windows. It being considered undesirable to have cattle on the same floor with swine, the whole ground floor has been left for pig pens, and the bull stalls built on the second floor. In this story, which is separated from the basement by a tight floor, a water-tight platform was built and on this were constructed five stalls, each six feet wide by seven feet long. At the front and rear of each partition is a six by six inch oak post. In a horizontal stick, six inches square, in front of the mangers, are ringed bolts to which the bulls are fastened by chains which are attached to a collar. On the floor of each stall are hard-wood slats, two inches wide, one and one-quarter inches apart, one inch thick at the front end and thick enough at the other to overcome the fall of the platform which is two inches in six feet. The drawings show the general plan of the stalls, and the plan, location and arrangement of the pig pens and yards. They also indicate the locations and general ground plans of the other buildings.

The pig pens have an average size of about nine by ten feet and all adjoining pens are connected by doors. The partitions and sides are three feet ten inches high, and those of the boar pens, four feet high with a gas-pipe rail one foot above. Under every alternate partition, which is separated by a half-inch space from the floor, is an open cement gutter, toward which the tight floors of the adjoining pens incline. The open gutters empty into small cistern traps which are on a line of glazed tile connecting with the large cisterns of the manure platform. An iron pipe connects the gutter of the bull stalls with this system of glazed tile, the location of which is shown by the dotted lines of the drawing.

The sliding doors opening into the passage-way and those connecting the pens are lifted by means of a rope over a small pulley at the ceiling. The doors opening into the yards swing on hinges at the side. In front of the trough one foot above the floor is a door two feet high, as long as the trough, swinging on hinges at the top. Cleats on the plank at each end of the trough serve as stops, to prevent the door swinging in further than enough to expose the trough. A large wooden bolt attached to the outside of this door serves to fasten the door open or shut. A perspective drawing, on a larger scale than that of the ground plan, helps to explain this arrangement and the drawings serve to complete the description of the pens.

This barn was in such a condition that immediate repair was necessary, and the pens were built with the intention of conducting experiments with swine similar to those now begun with poultry and cattle.

SORGHUM.

Eighty-two samples of sorghum seed and two of millet were planted this season. Fifteen were selected from the 165 samples (including about 100 varieties) grown last year, ten of them being the most valuable varieties for this latitude. Of the new varieties grown, for the first time, nine came from Java, two were received from Calcutta, seven from Algiers and three from Turkey. Thirty-three samples came from the Department of Agriculture.

A new variety of millet, received from Japan as sorghum, gave promise of considerable value. There was a large crop of good seed, although it was impossible to determine the yield on account of the English sparrows which infest this neighborhood. This variety will be tried in the field another season. The other variety of millet (from China) proved too late for a reliable crop.

None of the new sorghums from Java or Turkey proved of any value for sugar or syrup. Those from Turkey yield a good crop of seed, but mature too late on the soil here. The only one of the varieties from Algiers that is valuable for syrup matures too late for this latitude. The soil upon which the sorghums were grown is a rich clay loam and favorable to a large growth but slow maturity. The observations taken on the crop are condensed in the following table. The rows, from No. 1 to No. 19 inclusive, were planted May ninth; No. 71, May sixteenth; No. 72, May twenty-third; and all the others May fifteenth.

Those numbered 2, 3, 6, 7, 8, 9, 10, 11 and 72, are the only varieties that are to be recommended for syrup in this part of the State (although many others, only valuable for seed and fodder, can be matured). Of these mentioned varieties, Nos. 6, 9, 11 and 72 are the most reliable.

Row number.	NAME, ETC.	MATURITY.		Average height.	Average diameter.	Average weight.
		Panicle first appearing.	Seed ripe.			
				Feet.	Inch.	Ozs.
1 A.	Lall Jowar, India	Aug. 28	....	7.1	1.1	21.62
2...	Lall Jowar (var. bicolor), India	Aug. 22	....	8.3	1.0	27.41
3...	"White African"	Aug. 20	....	9.6	.9	22.41
3 A.	"White African" (other seed)	Aug. 18	....	9.5	.8	23.00
4 A.	Doodhia Jowar, India	Sept. 4	....	7.6	.9	18.00
6...	Black Sorghum (var. bicolor), India	Aug. 16	....	8.0	.8	20.33
7...	Neeazana	Aug. 16	....	7.9	.8	18.25
8...	Jyangentombi, Natal	Aug. 24	....	10.2	.9	21.50
9...	Boomvana (Early Amber)	Aug. 13	Sept. 29	8.9	.8	22.79
10...	Koombana	Aug. 20	Sept. 30	9.5	.8	18.00
11...	"Pootung Sorghum," China	Aug. 22	Oct. 11	10.2	.9	24.50
12...	Ukubane, Natal	Aug. 31	....	6.2	1.0	21.80
13...	Giddtambadee Jowaree, India	Sept. 9	....	8.8	1.0	27.90
14...	San Sin Pai Liang, China	Aug. 26	....	11.6	1.0	22.50
15...	Vimbischuapa	Sept. 4	....	10.7	1.1	50.37
16...	Vimbischuapa (other seed)	Sept. 4	....	10.9	1.3	.....
17...	"Whitney's Early"	July 31	Sept. 19	7.6	.8	11.50
18...	"Early Tennessee"	Aug. 3	Sept. 21	7.4	.6	13.60
19...	Handimodadi Jowaree, India	Oct. 2	....	7.3	1.0	.....
71...	Millet from Japan	Aug. 13	Sept. 21	4.0	.3	.....
72...	"Early Variety" from S. H. Kenney	Aug. 23	Oct. 2	8.5	.8	20.37
33...	"Sorghum Saccharatum," Buitenzorg, Java.	Aug. 24	Oct. 7	8.7	.6	10.04
34...	Sorghum Saccharatum, Thanawa, Java	Sept. 4	Oct. 11	9.7	.8	12.00
35...	Sorghum Vulgare (?), Java	Aug. 17	Oct. 2	10.7	.6	9.70
36...	Sorghum leneas pumam, Java	Aug. 20	Oct. 8	9.2	.6	8.00
37...	Sorghum, Pontianark, Java	Aug. 26	....	10.4	.9	13.58
38...	Sorghum, Haut teana, Java	Sept. 7	....	10.5	.8	18.00
39...	Sorghum Glycyphyllum, Java	Sept. 5	....	9.4	.9	11.70
40...	Sorghum Elongatum, Buitenzorg, Java	Aug. 24	Oct. 12	9.0	.6	9.80
41...	Sorghum Nigrum, Java	Aug. 24	Oct. 10	9.1	.6	12.25
46...	Sorghum Kaffrarium, Calcutta	Sept. 17	....	9.7	.8	12.12
47...	"Sorghum Saccharatum or Chinese Sugar Cane," Calcutta	Sept. 16	....	5.9	.6	7.00
48...	"Sorghum Early Amber from Minn."	Sept. 18	....	7.0	.8	16.12
60...	Sorgho Orange hatif, Algiers	Sept. 2	....	6.3	.8	12.87
61...	Sorgho à Sucre, Algiers	Aug. 28	....	8.1	.9	.....
62...	Sorgho à Ballais, Algiers	Aug. 22	....	10.7	.8	14.45
63...	Sorgho blanc du Senegal, Algiers	....	....	7.2	1.0	18.08
64...	Sorgho sucré de Changalard, Algiers	Sept. 1	....	10.3	.9	22.29
65...	Sorgho Riz de Changalard, Algiers	Aug. 22	....	9.4	.6	16.50
66...	Sorgho blanc de Changalard, Algiers	Oct. 10	....	9.5	.8	22.37
67...	Sorghum, Turkey	Aug. 29	....	6.6	.9	.....
69...	Sorghum (white seed), Turkey	Aug. 29	....	6.0	.9	.....
70...	Sorghum (rose-colored seed), Turkey	Aug. 29	....	6.4	.8	.....
200...	"Swain's Early Golden," D. of A.	Aug. 28	Oct. 11	10.1	.8	25.16
201...	"Whiting's Early," D. of A.	Aug. 17	Sept. 30	7.7	.6	17.25
202...	"Folger's Early," D. of A	Aug. 29	Oct. 10	10.4	.6	20.00
203...	"Early Tennessee," D. of A.	Aug. 16	Oct. 3	8.7	.8	19.50
204...	"Early Amber," D. of A.	Aug. 28	....	10.4	.8	22.58
205...	"Early Orange," D. of A.	Sept. 4	....	8.1	.6	14.16
206...	"Improved Orange," D. of A.	Sept. 9	....	7.3	.8	14.00
207...	"New Orange," D. of A.	Sept. 9	....	7.5	.6	12.62
208...	"Dutcher's Hybrid," D. of A.	Aug. 29	....	8.2	.6	10.83
209...	"White African," D. of A.	Sept. 2	....	8.7	.8	15.50
210...	"Late Orange," D. of A.	Sept. 4	....	7.4	.9	22.04
211...	"Kansas Orange," D. of A.	Sept. 10	....	7.7	.9	21.95
212...	"Red Liberian," D. of A.	Sept. 18	....	7.8	.8	14.08
213...	"Link's Hybrid," D. of A.	Sept. 14	....	8.4	.8	18.00
214...	"Price's New Hybrid," D. of A.	Aug. 26	....	10.0	.9	25.54
215...	"Honey Dew," D. of A.	Sept. 2	....	8.8	.8	13.66
216...	"Enyama," D. of A.	....	....	6.0	.9	18.91
217...	"New Variety from Texas," D. of A.	Sept. 14	....	8.9	.9	27.70
218...	"New Sugar Cane," D. of A.	Sept. 8	....	8.3	.9	20.25
219...	"White India," D. of A.	Aug. 30	....	9.6	.8	12.37
220	"Sorghum orig. from Cape Town," D. of A.	Sept. 6	....	7.8	.9	19.00

Row number.	NAME, ETC.	MATURITY.		Average height.	Average diameter.	Average weight.
		Panicle first appearing.	Seed ripe.			
				Feet.	Inch.	Ozs.
221...	"New Variety from India," D. of A	Sept. 6	....	8.0	.6	17.16
222...	"Waubansee," D. of A.	Sept. 3	....	8.2	.8	20.45
223...	"Planters' Friend," D. of A.	Sept. 14	....	6.4	.8	13.00
224...	"A New Variety from Georgia," D. of A.	Aug. 31	....	8.3	.6	16.12
225...	"An Unknown Variety," D. of A.	Aug. 31	....	7.4	.8	18.70
226...	"Unnamed Variety from East India," D. of A.	....	....	5.6	.8	16.54
227...	"An Unnamed Variety," D. of A	Sept. 15	....	6.9	.8	18.37
228...	"An Unnamed Variety," D. of A	Sept. 4	....	8.2	.8	15.20
229...	"Chinese," D. of A.	Sept. 2	....	9.5	.8	13.12
230...	"An Unnamed Variety," D. of A	Sept. 10	....	8.3	.6	16.83
231...	"Honduras," D. of A.	Sept. 14	....	9.2	.8	12.58
232...	"Goose Neck," D. of A	Sept. 10	....	7.5	.8	17.45
233...	"No. 53 from South Africa," D. of A.	....	....	5.2	.9	12.04

The juices from canes of several varieties were analyzed with the following results:

Row number.	NAME, ETC.	Date.	Weight of cane, ounces.	Per cent of juice.	Sp. Gr. of juice.	Per cent solids not sugar.	Per cent of glucose.	Per cent of sucrose.
2..	Lall Jowar (var. bicolor)	October 16	23.50	65.32	1.055	3.85	1.38	8.51
3..	White African	October 24	25.25	60.79	1.056	3.68	1.75	8.54
3A	White African (other seed)	October 16	24.25	67.01	1.055	4.16	1.48	8.10
6..	Black Sorghum (var. bicolor)	October 11	19.50	66.41	1.064	4.31	.95	10.76
6..	Black Sorghum (var bicolor)	October 12	23.50	68.51	1.072	4.36	1.00	12.47
6..	Black Sorghum	October 14	18.00	68.61	1.058	4.94	1.01	8.54
7..	Neeazana	October 18	18.25	69.07	1.056	3.36	2.72	7.89
8..	Jyangentombi (?)	October 18	21.50	46.98	1.075	5.47	.91	12.17
9..	Boomvana (early amber)	October 8	18.50	72.70	1.066	3.11	1.76	11.39
9..	Boomvana	October 10	18.00	69.17	1.063	3.24	2.44	10.08
9..	Boomvana	October 12	21.25	70.35	1.066	2.93	2.09	11.24
10..	Koombana	October 10	14.50	47.93	1.061	3.91	1.11	10.34
10..	Koombana	October 18	21.50	58.14	1.076	3.17	1.81	13.69
10..	Koombana	October 24	18.00	56.67	1.074	4.69	1.54	12.05
11..	Pootung Sorghum	October 8	20.50	46.10	1.074	5.41	.79	12.08
11..	Pootung Sorghum	October 11	32.50	68.31	1.072	3.66	1.67	12.50
11..	Pootung Sorghum	October 24	20.50	41.95	1.076	5.90	1.14	11.63
13..	"Giddtambadee Jowaree"	October 18	14.25	54.39	1.048	5.26	1.55	5.29
15..	Vimbischuapa	October 22	56.25	59.11	1.068	.....	.....	.....
15..	Vimbischuapa	October 22	44.50	64.83	1.070	4.29	2.01	11.13
17..	"Whitney's Early var."	October 7	10.50	68.81	1.046	4.25	3.73	3.60
18..	"Early Tennessee"	October 7	12.75	65.40	1.043	4.34	3.28	3.51
33..	Sorg. Saccha. (Java), average of two canes	October 8	10.00	43.62	1.045	5.70	1.56	4.21
40..	S. Elongatum (Java), average of four canes	October 9	11.44	45.25	1.036	5.22	1.63	2.42
65..	S. Riz de Changalard (Algiers), average of two canes	October 9	33.00	46.82	1.065	4.30	1.91	9.90
66..	S. Blanc de Changalard (Algiers), in bloom	October 16	23.50	60.00	1.058	2.75	4.36	7.38
72..	"Early var." from S. H. Kenney	October 8	24.75	71.51	1.074	3.41	2.48	12.39
72..	"Early var." from S. H. Kenney	October 14	22.00	69.32	1.074	3.64	2.10	12.54
72..	"Early var." from S. H. Kenney	October 18	16.25	67.69	1.071	3.40	2.95	11.26
	Odd cane, row 17	October 24	21.50	63.95	1.061	3.41	3.83	8.12
	Odd cane, row 17	October 24	22.50	66.00	1.057	.....	.....	.....
	Average from plats for ensilage	October 16	20.06	66.07	1.068	2.08	3.78	10.95

The following is the average of all the analyses of seven varieties of sorghum grown this year. There is also given the average of analyses of the same varieties grown last year, and from which seed was taken for this year's planting.

	Average per cent of juice.	Average per cent of solids not sugar.	Average per cent glucose.	Average per cent surrcose.
1889	61.06	4.12	1.50	10.87
1888	59.12	3.51	2.12	9.02

Juices from canes which had been standing in the field a month after the temperature had been down to 21 degrees Fahrenheit (the temperature meanwhile having ranged from 17.8 to 61.7 degrees), analyzed as follows:

	Per cent juice.	Specific gravity of juice.	Per cent solids not sugar.	Per cent glucose.	Per cent sucrose.
Row 72	55.52	1.081	5.42	6.10	8.25
Row 9	57.22	1.076	5.84	4.44	8.39

REPORT OF THE CHEMIST.*

The work of this department has been almost entirely devoted to investigations with fodders and to feeding experiments, including the determination of the digestibility of certain feeding stuffs. The questions discussed in this report are:

1. Composition of feeding stuffs.
2. Nitrogen-free extract of foods, its composition and digestibility.
3. A study of the maize plant, with special reference to the chemistry of its growth.
4. Cattle foods and feeding rations.
5. The feeding experiment with dairy animals.

During the winter of 1888–9 experiments were conducted with four young animals and two cows.

1. Feeding experiments:
    - *a.* Two animals receiving nitrogenous rations.
    - *b.* Two animals receiving carbonaceous rations.
2. Digestion experiments:
    - *a.* Digestibility of nitrogenous ration.
    - *b.* Digestibility of carbonaceous ration.
    - *c.* Digestibility of hay used in above rations.
    - *d.* Influence of roots in above ration.
    - *e.* Digestibility of a milk ration.
    - *f.* Digestibility of alfalfa hay.
3. Relative feeding value of some grain rations.
4. Notes from the dairy.

Besides the above there is now in progress a large amount of work with ensilage, with special reference to the changes which take place in the silo resulting in loss of dry matter. The results of this experiment and the digestibility of maize fodder, as compared with maize ensilage from immature corn and mature corn, will be given in a future report.

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* E. F. Ladd.

During the year I have prepared Bulletins Nos. 16 and 17, also a part of Bulletin No. 18 included in this report. I have also prepared an exhibit, for the State Agricultural Society's show at Albany, illustrating the chemical composition of our more common feeding stuffs, including milk. This exhibit attracted considerable attention as an object lesson, and I have since prepared one illustrating the chemical composition of milk and butter for the instructors at the dairy conferences. At the request of the president and secretary of the State Agricultural Society, I have prepared for use at the institutes a similar exhibit of ten of the common feeding-stuffs in general use by farmers. I have also been in attendance at several of the institutes in different parts of the State.

A much smaller number of commercial fertilizers have been analyzed the past season than the previous year. The State having failed to enact the necessary laws and make provision for carrying on the work, we were obliged to devote our energies to the chemical work absolutely necessary for carrying out the contemplated dairy experiment.

In our present overcrowded and ill-adapted quarters it will be impossible to carry to successful completion the necessary chemical investigations connected with the valuable experiments already under way with the different breeds of dairy animals. An opportunity for doing such valuable scientific work, which should tend to practical results, is seldom afforded and should not be lost by lack of proper facilities for making the investigations. With a new laboratory properly equipped and two more assistants and a bookkeeper, the work can be carried to successful completion and much done in the way of determining the influence of food on the animal products — milk, butter and cheese.

In closing this introductory note I wish to express my obligation to all whose approval and coöperation has made successful many of these experiments, which without their aid would have been impossible. The chemical work connected with the experiment with dairy animals has been almost wholly done by Mr. Whalen, the assistant chemist, and to him much credit is due for aid in the work represented in this report.

ANALYSES OF FOODS.

As heretofore, considerable attention has been given to analyses of foods, and, while some of them are discussed under appropriate heads, many of a more or less miscellaneous nature are brought together at this place in tabular form. A few notes descriptive of some of the foods will add to the value, and using the serial numbers we give the following:

Nos. 1 to 4 inclusive were from the four successive cuttings of alfalfa from the same lot and cut in early bloom for the dairy animals.

Nos. 5 to 8 inclusive were mixed grasses cut in bloom and were from duplicate, unfertilized plats.

Nos. 12 to 15 were from Burrill & Whitman corn taken at watery stage of kernels.

Nos. 17 to 20, King Philip corn cut between period of glazing and full ripeness.

No. 32 was an excellent quality of alfalfa hay used in the digestion experiment for the winter of 1888.

Nos. 43 and 44 were samples of wheat middlings sent to the station for analysis by Mr. T. L. Cook, Palmyra.

No. 45 was a sample of rye bran from G. C. Thomas, Waterloo.

No. 46, a sample of buckwheat hulls from Dean & Burt, Owego.

No. 51, a sample of feed from Smiths, Powell & Lamb, Syracuse. Examination indicated that it was a by-product from oats in the manufacture of some food and had probably been roasted.

Nos. 52, 53 and 54 were samples of products sent to the station by the Atlantic starch works, South Brooklyn, and is claimed to have been prepared without the use of any chemicals. No. 2 is the same product as No. 1, but cooked in process of drying.

No. 59 is a mixture made up of the following: Wheat bran, 10 parts; linseed meal, 6 parts; oats crushed, 4 parts.

Laboratory number.	GRASSES, CLOVERS AND FORAGE PLANTS.	FRESH SUBSTANCE.						DRY SUBSTANCE.					Serial number.
		Water.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	
2739....	Alfalfa	80.91	1.98	4.26	5.15	6.88	.82	10.38	22.31	26.97	36.04	4.30	1
2803....	Alfalfa	76.72	1.85	4.34	7.15	8.86	1.08	7.96	18.63	30.69	38.06	4.66	2
2868....	Alfalfa	78.53	1.81	4.61	6.18	7.78	1.09	8.44	21.50	28.79	36.18	5.09	3
2782....	Meadow grasses, J.	68.33	1.57	2.87	10.58	15.18	1.47	4.97	9.06	33.42	47.90	4.65	4
2795....	Meadow grasses, J.	66.36	1.74	2.90	12.07	15.34	1.59	5.18	8.63	35.88	45.58	4.73	5
2777....	Meadow grasses, E	66.82	1.70	2.82	11.54	15.52	1.50	5.14	8 50	34.78	47.04	4.54	6
2790....	Meadow grasses, E	65.39	1.72	3.09	11.55	16.56	1.69	4.98	8.94	33.38	47.80	4.90	7
2769....	Rye forage	79.04	1.47	2.85	7.77	7.82	1.05	7.02	13.62	37.08	37.23	5.05	8
2835....	Oat and pea forage	74.81	1.66	3.97	7.98	10.32	1.26	6.61	15.75	31.69	40.92	5.03	9
2877....	Hungarian grass	73.49	1.72	3.45	7.81	12.43	1.10	6.46	13.00	29.47	46.90	4.17	10
2873A..	Maize forage, B. & W	81.18	.85	1.87	5.29	10.14	.67	4.53	9.94	28.12	53.83	3.58	11
2873B..	Maize forage, B. & W	80.39	.88	1.97	5.06	11.02	.68	4.50	10.06	25.83	56.14	3.47	12
2873C..	Maize forage, B. & W	81.48	.88	1.71	5.21	10.18	.54	4.75	9.25	28.16	54.92	2.92	13
2873D..	Maize forage, B. & W	81.81	.92	2.04	4.79	9.76	.68	5.07	11.18	26.37	53.43	3.75	14
2870....	Theft	68.44	1.81	3.09	10.74	14.82	1.10	5.73	9.81	34.03	53.05	3.48	15
2874A..	King Philip corn	76.28	.80	2.43	5.05	14.46	.98	3.38	10.25	21.30	60.94	4.13	16
2874B..	King Philip corn	72.41	.80	2.50	5.82	17.01	1.36	2.90	9.06	21.09	62.02	4.93	17
2874C..	King Philip corn	74.47	.81	2.58	5.76	15.33	1.05	3.19	10.12	22.58	59.97	4.14	18
2874D..	King Philip corn	75.82	.84	2.31	6.64	13.20	1.19	3.48	9.56	22.91	59.13	4.92	19
2882....	Corn tops	84.82	.81	1.57	3.84	9.09	.87	5.37	10.35	25.34	52.33	5.74	20
2834....	Corn butts	88.42	.67	.77	4.44	5.05	.65	5.77	6.62	29.72	52.21	5.68	21
2833....	Corn leaves	84.99	1.11	2.13	5.18	5.51	1.08	7.39	14.19	34.56	36.64	7.22	22
2611....	Silage	78.34	1.06	1.58	6.32	11.38	1.32	4.88	7.31	29.18	52.51	6.12	23
2608....	Silage	81.08	.95	1.13	4.90	10.86	1.08	5.03	6.00	25.92	57.32	5.73	24
2881....	Beets	83.52	.71	1.91	1.01	12.75	.10	......	......	......	......	......	25
2674....	Turnips	91.26	.66	.99	1.16	5.60	.33	7.58	11.37	13.24	63.97	3.84	26
	HAYS.												
2581....	Hay, mixed grasses	14.29	4.19	7.88	28.91	41.93	2.80	4.89	9.19	31.73	40.92	3.27	27
2648. ..	Hay, meadow grasses	......	......	......	......	......	......	7.06	12.31	28.84	47.19	4.60	28
2736....	Hay, mixed grasses	10.17	5.53	11.17	38.21	36.14	3.78	6.27	12.44	36.97	40.11	4.21	29
2828....	Hay, mixed grasses	21.05	4.49	7.55	26.37	36.48	4.06	5.69	9.56	33.81	45.79	5.15	30
2676....	Alfalfa hay	15.02	6.69	13.81	27.28	34.97	2.26	7.88	16.25	32.11	41.10	2.66	31

	MEALS.												
2476....	Corn meal	13.60	1.23	9.50	1.79	69.54	4.34	1.42	11.00	2.07	80.48	5.03	**32**
2610....	Corn meal	20.04	1.45	10.39	1.41	62.92	3.79	1.82	11.75	1.76	79.93	4.74	**33**
2802....	Corn meal	9.18	1.26	11.30	1.23	73.04	3.99	1.39	12.44	1.35	80.42	4.40	**34**
2840....	Corn meal	......	......	......	......	......	......	1.67	14.06	2.64	76.31	5.32	**35**
2609....	Oats, crushed	15.39	2.52	11.10	7.18	60.70	3.11	2.98	13.12	8.49	71.73	3.68	**36**
	BY-PRODUCTS, ETC.												
2475....	Wheat bran	13.71	5.49	15.13	8.27	54.35	3.05	6.37	18.69	9.59	61.81	3.54	**37**
2646...	Wheat bran	......	......	......	......	......	......	6.24	17.25	9.07	62.68	4.76	**38**
2732....	Wheat bran	13.01	3.82	16.41	6.19	56.54	4.03	4.51	18.87	7.12	63.87	4.63	**39**
2734....	Wheat bran	9.83	5.89	15.50	9.63	56.07	3.08	6.53	17.19	10.68	62.18	3.42	**40**
2761....	Wheat middlings	10.67	1.17	15.52	2.26	68.85	1.53	1.31	17.37	2.53	77.08	1.71	**41**
2871....	Wheat middlings	12.69	.66	14.30	1.60	69.42	1.33	.79	16.38	1.83	79.48	1.52	**42**
2872....	Wheat middlings	12.39	2.62	19.49	4.27	57.93	3.30	2.99	22.25	4.88	66.11	3.77	**43**
2651....	Rye bran	10.58	4.46	15.87	5.06	60.14	3.89	4.99	17.75	5.66	67.25	4.35	**44**
2716....	Buckwheat hulls	7.50	1.96	4.86	50.71	34.13	.84	2.12	5.25	54.82	36.90	.91	**45**
2647....	Cotton-seed meal	......	......	......	......	......	......	7.14	52.81	4.15	24.46	11.44	**46**
2654....	Cotton-seed meal	9.23	6.52	41.93	6.55	25.03	10.47	7.19	46.19	7.22	37.57	11.83	**47**
2478....	Linseed meal	12.10	5.17	30.48	7.69	35.51	9.05	5.89	34.68	8.75	40.38	10.30	**48**
2733....	Linseed meal	8.18	5.56	33.55	8.67	37.43	6.61	6.06	36.56	9.44	40.74	7.20	**49**
2477 ...	Ground feed	6.20	2.92	19.05	5.52	59.08	7.23	3.11	20.31	5.89	62.98	7.71	**50**
2770....	Gluten No. 1	6.40	.85	77.69	1.17	13.62	.27	.91	83.00	1.25	14.55	.29	**51**
2771....	Gluten No. 2	5.72	1.69	83.38	1.47	5.63	2.11	1.79	88.44	1.57	5.96	2.24	**52**
2772....	By-product No. 3	5.73	1.26	5.53	1.76	86.73	1.99	1.34	5.87	1.87	88.81	2.11	**53**
2582....	Palm nut meal	8.23	3.53	16.29	25.79	33.34	12.82	3.85	17.75	23.81	40.62	13.97	**54**
2583....	Palm nut cake	8.53	3.94	16.92	19.58	40.74	10.29	4.31	18.50	21.41	44.53	11.25	**55**
2480....	Gluten meal	9.58	.68	30.12	2.73	50.26	6.53	.75	33.31	3.02	55.70	7.22	**56**
2479....	Dry feed No. 1	10.70	.84	19.53	4.71	57.89	6.33	.94	21.87	5.23	65.87	7.09	**57**
2735....	Mixed feed	10.63	5.09	20.89	9.92	49.14	4.33	5.69	23.37	10.10	54.99	4.85	**58**
2678....	Peanut meal	4.21	2.41	27.37	3.62	25.83	36.56	2.52	28.57	3.66	27.09	38.16	**59**
2681 ...	Peanut vine	6.25	5.64	12.65	27.34	34.00	14.12	6.02	13.50	29.16	36.26	15.06	**60**
2679....	Peanut hull	7.50	1.96	4.86	50.71	34.13	.84	2.12	5.25	54.82	36.90	.91	**61**
2680....	Peanuts, average	5.88	1.87	19.47	2.29	38.15	32.34	1.99	20.69	2.43	40.53	34.36	**62**
2838....	Meat scraps	......	......	......	......	......	......	6.28	46.56	5.31	......	41.95	**63**

ALBUMINOID AND AMIDE NITROGEN.

Determinations of the albuminoid and amide nitrogen have been made for most of the foods analyzed, and below are tabulated those for the preceding table:

Laboratory number.	GRASSES, ETC.	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Per cent of total nitrogen in amide form.
2739	Alfalfa	3.57	2.00	1.57	43.97
2803	Alfalfa	2.98	2.06	.92	30.87
2868	Alfalfa	3.44	2.30	1.14	33.13
2782	Meadow grasses	1.45	1.11	.34	23.45
2795	Meadow grasses	1.38	1.16	.22	15.93
2777	Meadow grasses	1.36	1.02	.34	25.00
2790	Meadow grasses	1.43	1.31	.12	8.39
2769	Rye forage	2.18	1.41	.77	35.32
2835	Oat and pea forage	2.52	1.72	.80	31.74
2877	Hungarian grass	2.08	1.45	.63	30.29
2873A	Maize forage, B. & W	1.59	1.04	.55	34.59
2873B	Maize forage, B. & W	1.61	1.10	.51	31.68
2873C	Maize forage, B. & W	1.48	1.11	.37	25.00
2873D	Maize forage, B. & W	1.79	1.18	.61	34.08
2874A	King Philip corn	1.64	1.32	.32	19.51
2874B	King Philip corn	1.45	1.35	.10	6.89
2874C	King Philip corn	1.62	1.18	.44	27.16
2874D	King Philip corn	1.53	1.45	.08	5.22
2832	Corn tops	1.64	1.15	.49	29.87
2834	Corn butts	1.06	.79	.27	25.47
2833	Corn leaves	2.27	1.28	.99	43.66
2674	Turnip	1.82	.99	.83	45.60
	HAYS.				
2581	Hay, mixed grasses	1.47	1.22	.25	17.00
2648	Hay, meadow grasses	1.97	1.84	.13	6.59
2736	Hay, mixed grasses	1.99	1.65	.34	17.09
2828	Hay, mixed grasses	1.53	1.19	.34	22.22
2676	Alfalfa	2.60	1.93	.67	25.78
	MEALS.				
2476	Corn meal,	1.76	1.76	....	....
2802	Corn meal	1.99	1.82	.17	8.54
2609	Oats, crushed	2.10	1.85	.25	11.90
	BY-PRODUCTS, ETC.				
2475	Wheat bran	2.99	2.69	.30	10.03
2646	Wheat bran	2.76	2.36	.40	14.49
2732	Wheat bran	3.02	2.85	.17	5.62
2734	Wheat bran	2.75	2.53	.22	8.00
2761	Wheat middlings	2.78	2.43	.35	12.59
2647	Cotton-seed meal	8.45	8.04	.41	4.85
2654	Cotton-seed meal	7.39	6.64	.75	10.14
2478	Linseed meal	5.55	5.51	.04	.72
2733	Linseed meal	5.85	5.41	.45	7.52
2477	Ground feed	3.25	3.09	.16	4.92

NITROGEN-FREE EXTRACT OF FOODS.

I have on previous occasions* called attention to the necessity of improving our methods of food analysis, especially as regards the so-called nitrogen-free extract, and I again repeat, "It would be far better to determine the sugars and starch and take the remainder by difference, even doing away, if necessary, with the determination of the crude fiber." The more chemical work I do on foods, especially when done in connection with feeding experiments, the more fully am I convinced that until we determine the sugars and starch of foods and take these into account in considering the results of feeding experiments, we shall be unable to reconcile the differences which separate the science and practice of cattle feeding.

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* Seventh Annual Report New York Experiment Station, p. 267.

SUGARS AND STARCH.

Laboratory number.	GRASSES, ETC.	Invert sugar.	Sucrose.	Starch.	Per cent nitrogen-free extract as sug'rs and starch.
2739....	Alfalfa..............................	2.20	2.16	11.89	45.09
2803....	Alfalfa..............................	2.04	3.28	17.10	58.90
2868....	Alfalfa	2.48	2.44	14.96	54.92
2782....	Meadow grasses....................	3.48	5.92	15.88	52.77
2795....	Meadow grasses....................	4.40	3.66	23.18	68.54
2777....	Meadow grasses....................	4.52	6.16	17.35	59.58
2790....	Meadow grasses....................	3.60	5.28	17.44	55.06
2769....	Rye forage	4.96	1.04	20.31	70.66
2835....	Oat and pea forage..................	3.04	1.76	17.84	55.35
2877 ...	Hungarian grass.....................	5.20	3.08	22.00	64.56
2873A..	Maize forage, B. & W...............	9.76	8.92	17.28	66.80
2873B..	Maize forage, B. & W...............	11.60	7.52	14.97	60.70
2873C...	Maize forage, B. & W...............	10.00	10.32	12.90	60.49
2873D..	Maize forage, B. & W...............	13.16	7.00	11.40	59.06
2874A..	King Philip	4.60	2.40	43.13	82.09
2874B..	King Philip	6.48	2.40	41.42	81.10
2874C...	King Philip	6.40	5.28	34.31	76.68
2874D..	King Philip	5.80	4.32	35.60	77.32
2832....	Corn tops............................	11.20	5.24	20.52	64.89
2834....	Corn butts...........................	21.40	4.80	7.90	65.31
2833....	Corn leaves	9.28	1.80	17.10	76.90
2611....	Silage	4.04	1.00	21.43	50.40
2881....	Beets	3.40	47.40	0	....
2674....	Turnips	25.40	4.88	21.04	80.22
	HAYS.				
2581....	Hay, mixed grasses.................	8.00	2.44	15.44	63.49
2648....	Hay, meadow grasses	6.40	2.80	13.09	47.23
2736....	Hay, mixed grasses.................	2.60	1.28	14.72	46.42
2828....	Hay, mixed grasses.................	4.08	1.64	18.54	52.98
2627....	Alfalfa..............................	3.00	1.40	12.73	41.68
	MEALS.				
2476....	Corn meal................	Trace.	2.40	69.92	89.86
2802....	Corn meal............................	1.28	1.60	76.68	98.98
2609....	Oats, crushed.......................	1.20	0	49.86	71.18
	BY-PRODUCTS, ETC.				
2475....	Wheat bran..........................	1.96	2.20	46.74	82.18
2646....	Wheat bran..........................	2.60	1.68	46.74	81.08
2732....	Wheat bran.......	Trace.	4.40	49.21	83.93
2734....	Wheat bran..........................	Trace.	5.40	44.40	80.09
2761....	Wheat middlings....................	1.20	2.00	72.48	96.87
2647....	Cotton-seed meal....................	0	5.96	6.15	49.50
2654....	Cotton-seed meal....................	0	9.92	8.43	48.84
2478....	Linseed meal........................	0.20	2.32	17.48	49.52
2733....	Linseed meal	0	1.80	22.80	60.38

In the previous tables I have given the results for the past season's work not elsewhere discussed for the sugars and starch of foods. Some very interesting results are manifest as shown by an inspection of the above table. In maize with B. and W. corn cut when in milk and King Philip corn at maturity, all cut for forage, we find the invert sugar ranging from 4.60 to 13.16 per cent, sucrose from 2.40 to 10.32, and starch from 11.40 to 43.13 per cent. Can the nitrogen-free extract of these foods have like nutritive value? Differences such as I have just indicated, though less marked, are found in hays, grains and waste products. A comparison of cotton-seed and linseed meals with corn meal indicates interesting differences which may throw some light on their feeding value and their proper place in feeding rations.

When we have studied more fully the composition of nitrogen-free extract we may find that the sugars and starch are a fair measure of its digestibility. Below, I present in parallel columns, the per cent of nitrogen-free extract as sugars and starch, and the average coefficient of digestibility for nitrogen-free extract as found by German and American investigators.

	Number of determinations.	Per cent of nitrogen-free extract, as sugars and starch.	Digestion coefficient for nitrogen-free extract.
Timothy, 1887	21	56	64
Timothy, 1888	8	69	64
Alfalfa (early bloom)	5	50	65 (hay)
Meadow grasses	8	54	63
Red clover (bloom)	21	35	70 (hay)
Hungarian grass	1	64	....
Rye forage	1	70	70
Maize forage (immature)	4	61	56
Maize forage (mature)	4	79	61
Sorghum forage	1	51	78
Maize ensilage	1	50	61
Oat straw	1	51	53
Wheat straw	1	60	40
Turnips	1	80	100?
Oats	2	76	73
Corn meal	3	92	89
Wheat bran	5	82	80
Cotton-seed meal	2	49	46
Linseed meal	2	55	91

With two exceptions, red clover and linseed meal, we find that the per cent of nitrogen-free extract, as sugars and starch, agrees very closely with the per cent digested. Until other experiments can be concluded I am unable to explain this difference for clover; but with linseed meal it is easily understood since the nitrogen-free extract is quite different from that of other grains and approaches more nearly the mucilaginous and pectose bodies common in certain foods. Further study and experimenting, I am confident, will so perfect the method as to enable us to estimate in the laboratory the digestibility of the nitrogen-free extract of foods, as we now do for the albuminoids.

WHEAT MIDDLINGS.

Two samples of wheat middlings were received at the laboratory from T. L. Cook. No. 1 was a fine white product, nearly as light-colored as flour, and No. 2 was coarse and more bran with a brownish hue. Mr. Cook desired to know, at the same price per ton, which would be the most valuable for growing and fattening pigs?

The following were the results of chemical analysis:

	No. 1.	No. 2.
Water	12.69	12.39
Ash	.66	2.62
Albuminoids (Nx 6.25)	14.30	19.49
Crude fiber	1.60	4.27
Nitrogen-free extract	69.42	57.93
Fat	1.33	3.30

The two points specially worthy of note in the above results are the differences in per cent of ash and albuminoids. For young and growing animals or cows in full milk this is a very important consideration. For fattening full-grown, well-developed animals there seems to be difference of opinion. Probably much will depend upon the nature of the other foods to be fed in combination with the middlings, also on the environments of the animals themselves.

A STUDY OF THE MAIZE PLANT.

In 1888 some attention was given at this Station to investigating the increase and chemical changes which take place in the maize plant during its period of growth, and it was decided to continue the investigations through 1889.

The three questions presenting themselves most forcibly for study were:

1. What is the best variety of corn to grow for the silo?
2. What is the best method of planting?
3. What is the proper stage of maturity for cutting corn for the silo?

In the past a larger amount of work has been done at this Station in the growing of maize for forage and other experimental purposes, and much of this data is in a line to aid in answering the questions we have already outlined.

Before coming to examine the results of the present season we may review the work already done at the Station. In 1884* several trials with varieties are recorded, and we first note the difference between hill and drill for a flint variety. Hills, forty-four by twenty-two inches; drills, forty-four inches, about twelve kernels to foot.

	Yield of forage.	Amount water per acre.	Dry matter.
	Tons.	Tons.	Tons.
Flint corn, in hills	16.39	13.04	3.35
Flint corn, in drills	10.01	8.07	1.94

The results are in accordance with the general belief that corn so thickly planted, as in the drills above, give smaller amount of dry matter than when planted at greater distance.

It is interesting to note the actual yield per acre of the several chemical constituents for thick planting and thin planting, as in the hills and drills just recorded:

	YIELD PER ACRE IN POUNDS.	
	In hills.	In drills.
Ash	237.85	136.58
Albuminoids	559.45	308.07
Crude fiber	1564.45	1019.66
Nitrogen-free extract	4159.38	2294.24
Fat	174.87	121.44

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* Third Annual Report New York Station, p. 102.

In 1884 corn for forage was planted thick, and the varieties we are about to consider were planted in drills forty-four inches apart, and about twelve kernels to the foot except the pop variety, and this was planted in drills twenty-two inches apart. Below we give the yield of green forage, the amount of water and of dry matter all expressed in tons, per acre :

	Forage per acre.	Water per acre.	Dry matter per acre.
Minnesota Dent	10.57	8.69	1.88
Evergreen Sweet	7.95	6.40	1.55
Waushakum Flint	10.01	8.07	1.94
New England Pop	11.06	9.67	1.39

The yield per acre for both green forage and dry matter was very low, but to what extent this is due to thick planting we can not fairly say. In 1885 several varieties of corn were planted in drill, about twelve kernels to the foot, and the distance between drills was varied, some plats being forty-four inches others twenty-two inches apart, and below we tabulate the results for the green forage, amount of water and dry matter expressed in tons per acre :

VARIETY.	Forage per acre.	Water per acre.	Dry matter per acre.
White Flint, drills 44 inches	23.26	20.20	3.06
Orange County Flint, drills 22 inches	27.37	19.36	8.01
Queen of Prairie Dent, drills 44 inches	18.13	15.25	2.88
Long Island White Dent, drills 22 inches	17.00	14.34	2.66
Sweet corn, mixed, drills 44 inches	20.33	17.46	2.87
Pop corn mixed, drills 44 inches	15.94	13.06	2.88
Pop corn, White Pearl, drills 44 inches	15.30	12.69	2.61
Pop corn, White Pearl, drills 22 inches	19.00	15.53	3.47

In 1886 *four varieties of corn were tested in two series of plats, twenty kernels to the foot were planted in drills. In series 1, drills forty-four inches apart; series 2, drills thirty inches apart.

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* Fifth Annual Report New York Station, p. 46.

For this year we have only the yield of green forage in tons, per acre, as follows:

	Series I.	Series II.
Waushakum	11.19	19.05
Yankee Dent	12.88	18.21
Stowell's Evergreen, sweet	9.99	13.06
Pearl pop	11.74	11.51
Mixture of all	15.08	14.61

It is noticeable that the yield per acre of green forage was greater for the thick seeding for each variety except the pop.

The average for four-year trials is summarized * as follows, regardless of variety:

Tons of green forage per acre.

	Average tons of forage per acre.
Flint corn	15.88
Dent corn	14.95
Sweet corn	12.83
Pop corn	12.63

From the trials as summarized, it appears that the flint corns give, under the method of thick seeding, the greatest amount of green forage per acre, and four years' trials should give a fair test including as they do, several well-known varieties.

The corns were cut, as a rule, at the stage when the pollen was falling.

The question we now have to consider, is, whether the method of planting in drills with the stalks so close, twelve or more to the foot, was the most favorable for the production of the greatest amount of forage. The flint corn, planted in hills and drills, indicates that the corn in drills was too thick for best growth. The trials in the following year on this point are conflicting, but we do not have the same two varieties for comparison, hence must look elsewhere for our answer. In 1886 we have direct comparison for twenty kernels to the foot in drills forty-four inches apart and drills thirty inches apart. With flint, dent and sweet corn, the results for total yielded of green forage is decidedly in favor of thick seeding, as already shown in series 1 and 2. We can not say, however, that a greater yield of dry matter would have been secured with four or six kernels to the foot.

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* Fifth Annual Report New York Station, p. 47.

Like results have been obtained with planting amber cane for forage, as shown below:

	Forage per acre.	Water per acre.	Dry matter per acre.
	Tons.	Tons.	Tons.
Early Amber Cane, drills 44 inches	23.84	20.33	3.51
Early Amber Cane, drills 44 inches	23.75	20.15	3.60
Early Amber Cane, drills 22 inches	27.41	23.18	4.23
Early Amber Cane, drills 22 inches	25.20	21.02	4.18

In dry matter we see a decided increase by thicker seeding and we have confirmed the general results obtained with corn.

As these plats growing amber cane were in comparison with the corn plats in 1885, we see the relative yield of corn and amber cane as forage crops; corn averaging 3.55 tons of dry matter per acre and amber cane 3.88 tons. There seems to be no question then but what the greatest amount of green forage and dry matter has been produced at this Station by thick seeding. Whether by thin seeding, as in the case of hill and drill trials, a greater yield would have been secured may be questioned. Under what conditions the greatest amount of digestible matter would be secured remains for further investigation.

The next point we come to consider is, "What is the amount of increase in the maize plant as it approaches maturity?" As a first step in this direction we can have no better data than is found in the experiment by Dr. Babcock.*

In a plat of flint corn, Waushakum corn, Babcock selected thirty stalks on August eighteenth, each bearing two ears and as much alike in general appearance as could be determined by a superficial examination. At this date the kernels of corn were just beginning to swell, and beginning at this date analyses were made at intervals of one week to September twenty-third. Five stalks were selected at each cutting and measurements, analyses, etc., made of each individual stalk.

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* Second Annual Report, 1883, p. 153.

Rearranging the table to serve our purpose we have the following:

DATE OF SAMPLING.	Height of stalk, feet.	WEIGHT OF STALK, GRAMS.		Per cent water.	Per cent dry substance.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).
		Fresh.	Dry.							
August 18:										
Stalk 1	6.25	777.0	98.5	87.32	12.68	4.87	9.81	25.70	57.30	2.32
Stalk 2	7.80	953.0	132.4	86 11	13.89	5.03	10.06	27.14	55.42	2.35
Stalk 3	7.00	911.0	135.5	85.12	14.88	4.50	11.19	28.24	53.84	2.23
Stalk 4	7.10	896.0	126.2	85.91	14.09	5.00	10.12	30.15	52.39	2.34
Stalk 5	6.60	1,014.0	142.0	85.99	14.01	4.41	10.31	25.97	57.19	2.12
Average	**6.95**	**910.0**	**126.9**	**86.05**	**13.95**	4.76	**10.30**	27.44	**55.23**	**2.27**
August 25:										
Stalk 1	6.50	1,265.0	177.3	85.99	14.01	5.01	12.19	27.95	52.97	1.88
Stalk 2	6.75	847.0	134.0	84.18	15.82	4.73	10.94	28.32	53.97	2.04
Stalk 3	6.90	864.0	150.3	82.60	17.40	3.98	11.06	25.31	57.60	2.05
Stalk 4	7.60	1,032.0	153.0	84.20	15.80	4.22	10.19	28.09	55.67	1.83
Stalk 5	7.00	912.0	137.0	84.94	15.06	4.38	12 25	26.66	54.64	2.07
Average	**6.95**	984.0	**151.3**	84.38	**15.62**	**4.46**	**11.32**	27.27	54.98	**1.97**
September 1:										
Stalk 1	6.90	986.0	177.7	81.98	18.02	4.31	10.44	25.95	57.36	1.94
Stalk 2	5.75	684.0	149.0	78.16	21.84	4.37	10.84	22.34	60.21	2.14
Stalk 3	6.60	1,325.0	226.3	82.92	17.08	5.03	12.13	20.06	60.77	2.01
Stalk 4	7.50	1,028.0	159.0	84.53	15.47	3.76	9.81	28.73	55.91	1.79
Stalk 5	7.80	1,060.0	196.3	81.48	18.52	4.25	9.25	25.74	58.74	2.02
Average	**6.91**	1,017.0	181.7	81.81	18.19	**4.34**	**10.51**	24.56	58.58	**1.98**
September 8:										
Stalk 1	7.33	988.0	224.0	77.33	22.67	3.79	9.56	21.67	62.96	2.02
Stalk 2	7.00	1,185.0	279.5	76.41	23.59	3.69	9.44	19.54	64.68	2.65
Stalk 3	7.00	1,004.0	229.5	77.14	22.86	3.93	9.94	20.14	63.55	2.44
Stalk 4	7.10	1,182.0	252.0	78.68	21 32	4.10	9.50	18.55	65.58	2.27
Stalk 5	7.82	1,016.0	232.0	77 16	22.84	3.87	10.13	19.19	63.94	2.87
Average	7.25	1,075.0	243.8	77.34	22.66	3.88	9.71	19.82	**64.14**	**2.45**
September 15:										
Stalk 1	7.00	948.0	245.0	74.15	25.85	3.41	8.44	19.17	66.28	2.70
Stalk 2	7.00	742.5	191.0	74.28	25.72	3.05	8.75	19.16	66.67	2.37
Stalk 3	6.25	811.0	201.0	75.21	24.79	4.78	11.13	16.41	64.66	3.02
Stalk 4	7.42	977.0	257.0	73.69	26.31	3.44	9.63	20.35	63.84	2.74
Stalk 5	8.00	1,282.0	285.5	77.73	22.27	3.23	9.56	21.07	63.98	2.16
Average	**7.13**	**952.1**	235.9	75.01	24.99	3.58	9.50	19.25	65.07	**2.60**
September 23:										
Stalk 1	7.90	960.0	298.5	68.91	31.09	3.05	7.94	20.88	65.66	2.47
Stalk 2	6.42	1,134.0	359.0	68.34	31.66	2.95	9.19	17.19	67.50	3.17
Stalk 3	7.33	1,276.0	395.0	69.04	30.96	2.77	9.81	16.49	67.68	3.25
Stalk 4	6.33	845.0	271.0	67.93	32.07	3.19	9.31	25.42	59.11	2.97
Stalk 5	7.60	1,203.0	310.0	74.14	25.86	2.97	8.50	20.85	64.82	2.86
Average	7.12	1,084.0	326.7	69.67	30.33	2.98	8.95	20.17	64.96	**2.94**

The table presented is interesting not only in showing the relative increase in the stalks, but also the variation in the chemical composition of individual stalks.

From the averages given in the last table we may construct another table giving the actual amounts for the several periods from formation of kernel up to full maturity. Such a table is presented below:

AVERAGE FOR	Dry substance.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.
	Grams.	Grams.	Grams.	Grams.	Grams.	Grams
August 18	126.9	7.04	13.07	34.82	70.08	2.88
August 25	151.3	6.74	17.12	41.25	83.18	2.98
September 1	181.7	7.88	19.09	44.62	106.44	3.59
September 8	243.8	9.45	23.67	48.32	156.37	5.97
September 15	235.9	8.44	22.41	45.41	153.54	6.13
September 23	326.7	9.73	29 23	65.89	212.22	9.60

The above table is interesting in showing the gradual increase, with the exception of the five stalks cut September fifteenth which did not prove to be an average lot, and illustrates the great difficulty of selecting or in sampling corn so as to fairly represent the entire crop.

It was intended in this connection to have considered the work already done at other stations, but the great mass of accumulated data renders it impossible to do anything like justice and keep within the limits of the present article. The whole should be thoroughly digested and published as a monograph.

EXPERIMENTAL WORK OF 1888.

Briefly reviewing the work of 1888,* we have the following summary:

		Pounds.	Tons per acre.
September 11	Corn per acre	25,326	12.66
September 29	Corn per acre	25,011	12.50

The total yield per acre of the chemical components was as follows:

PER ACRE.	Sept. 11.	Sept. 29.	Increase.
	Pounds.	Pounds.	Pounds.
Water	20,322	19,351	
Dry matter	5,004	5,660	
Ash	215	237	
Albuminoids	525	512	
Crude fiber	1,443	1,650	

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* Bulletin No. 16, New York Agricultural Experiment Station.

PER ACRE.	Sept. 11.	Sept. 29.	Increase.
	Pounds.	Pounds.	Pounds.
Nitrogen-free extract	2,696	3,109	
Fat	125	188	
Total nitrogen	84.07	80.94	
Albuminoid nitrogen	50.04	66.79	
Amide nitrogen	34.03	14.15	
Glucose	580.46	751.49	171.03
Sucrose	390.31	633.92	243.61
Starch	908.72	1,077.10	168.38
			583.02

The variety of corn was B. & W. and September eleventh, the date of first cutting ranged from full silk to watery stage of kernels; September twenty-ninth from watery stage to full milk.

EXPERIMENTS IN 1889.

The present season our experiments have been restricted to the one question, "What is the best stage for cutting corn for the silo?" The chemical work, to determine the changes in the corn at the several stages of growth, has been quite complete. For the purpose of our experiment King Philip corn was selected. In the latter part of July, in a field of some twelve acres, one acre was selected that to all appearances was as nearly uniform in growth as possible to select and measured off. The plot included forty rows and these were divided into five sets, one-fifth acre each. This gave eight rows to each fifth acre, and, in order that any inequality in the land or growth of the corn might be counterbalanced so far as possible, it was decided at each cutting of the corn to take rows from each plot. The corn, as fast as cut, was piled upon a wagon, drawn to the barn, weighed and immediately run through the ensilage cutter and eight samples selected from the mass for water determination and analysis. Five cuttings were made and the dates and stage of growth are shown below:

Date of cutting.	Stage of growth.
July 30	Full tasseled.
August 9	Full silked.
August 21	Kernels watery to full milk.
September 7	Kernels glazing.
September 23	Ripe.

The yield per acre and the per cent of water for each period were as follows:

	Pounds per acre.	Per cent water.
July 30	18,045	91.05
August 9	25,745	88.05
August 21	32,000	85.76
September 7	32,295	77.70
September 27	28,460	72.18

The greatest weight per acre of green matter was at period of watery stage of kernel to full milk but the largest per cent of water as would be expected was at the first cutting, when 9.02 tons per acre were cut and of this amount 8.21 tons was water 0.81 tons of dry matter and in this connection the words of Professor Robertson at an institute in Wisconsin seem fully justified. In speaking of corn so planted as to be cut for forage at this stage of growth he said: "Fodder corn sown broadcast does not meet the needs of milking cows. Such a fodder is mainly a device of a thoughtless farmer to fool his cows into believing that they have been fed when they have only been filled up." A cow of 1,000 pounds live weight in order to get the amount of dry matter called for by the German standards would have to eat per day 300 pounds of corn forage such as we just been considering. At the second cutting we have 11.33 tons of water and 1.54 tons of dry matter in the 12.87 tons of forage. At full maturity we have an average crop of 14.23 tons with less water than at the period of tasseling and nearly five times as much dry matter.

	Corn, tons per acre.	Tons water per acre.	Tons dry matter per acre.
July 30	9.02	8.21	.81
August 9	12.87	11.33	1.54
August 21	16.30	13.97	2.33
September 7	16.14	12.51	3.63
September 23	14.23	10.27	3.96

The composition of the dry matter for each period shows percentagely a gradual decrease for all the components except nitrogen-free extract, which rises from forty to nearly sixty-one per cent. The per cent of nitrogen steadily diminishes through the series, while the sugars rise and fall. The starch falls slightly in per cent through the first three periods, and then increases rapidly until maturity.

	July 30.	Aug. 9.	Aug. 21.	Sept. 7.	Sept. 23.
Ash	8.58	6.54	5.00	4.20	4.60
Albuminoids	14.81	14.19	10.31	8.94	8.56
Crude fiber	31.76	28.36	27.18	24.38	21.90
Nitrogen-free extract	40.39	45.46	52.58	58.87	60.97
Fat	4.46	5.45	4.93	3.61	3.97

Per cent in dry substance.

	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.	Glucose.	Sucrose.	Starch.
July 30	2.37	1.69	.68	3.60	.56	17.55
August 9	2.27	1.45	.82	9.76	3.60	15.96
August 21	1.65	1.30	.35	14.32	2.80	15.20
September 7	1.43	1.09	.34	10.00	1.32	24.09
September 23	1.37	1.15	.22	6.80	1.88	36.02

It is interesting to note the differences in percentage composition with each stage of growth of the corn, but it is only when we consider the total yield per acre that we are able to fully understand the increase which has taken place in the crop itself.

CHEMICAL CHANGES IN THE CROP.

The total yield per acre at the date of last cutting was not so large as at the time of the two previous cuttings, but the dry

PER ACRE.	Tasseled July 30.	Silked August 9.	Milk August 21.	Glazed Sept. 7.	Ripe Sept. 23.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Yield per acre	18045.	25745.	32600.	32295.	28460.
Water per acre	16426.	22666.	27957.	25093.	20542.
Dry matter per acre	1619.	3078.	4643.	7202.	7918.
Ash	138.91	201.30	232.15	302.48	364.23
Albuminoids	239.77	436.76	478.69	643.86	677.78
Crude fiber	514.19	872.93	1261.97	1755.85	1734.04
Nitrogen-free extract	653.91	1399.26	2441.29	4239.82	4827.60
Fat	72.20	167.75	228.90	259.99	314.34

matter steadily increased. From the date of full tasseling until ripe the dry matter increased 4.8 times or from 1,619 pounds to 7,918 pounds per acre. From full silking until ripe the increase in dry matter was 2.5 times. Last year in our experiments we found no increase in albuminoids with B. & W. corn between the periods of full silk and watery stage of kernels. We note that while in this experiment for the same period of growth there was some increase in albuminoids, yet it was much less than for the previous or following period.

CHEMICAL CHANGES IN THE ALBUMINOIDS.

It is interesting to note the changes taking place in the albuminoids during the period of growth. It is noticeable that there are two periods of smallest gain in total nitrogen.

Pounds of nitrogen per acre.

		Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.
July 30.....	Tasseled..........	38.37	27.36	11.01
August 9.....	Silked	69.87	44.63	25.24
August 21.....	Kernels in milk	77.61	66.36	17.25
September 7.....	Corn glazed	102.99	78.50	24.49
September 23.....	Corn ripe	108.47	91.06	17.41

And there are also the periods of minimum amide nitrogen. Thus it appears that between periods of silking and corn in milk there is small gain in nitrogen, and this corroborates the work of last season with B. & W. corn. At this stage of growth the amide nitrogen is largely transformed into albuminoid nitrogen. Following the period just mentioned, corn in milk, there is a large increase in nitrogen, and the amide nitrogen increases in greater proportion than does the albuminoid nitrogen. It is at this period of growth that it is essential that there be present in the soil nitrogen in a form available as plant food. During the ripening stage there is little increase of total nitrogen, but the amide nitrogen is transformed into albuminoid nitrogen.

NITROGEN-FREE EXTRACT.

It is in the nitrogen-free extract or carbohydrates that the greatest increase has taken place, and to learn what is the nature of this increase was the object of our further investigation.

Amount per acre for different stages of growth.

		Glucose.	Sucrose.	Starch.
		Pounds.	Pounds.	Pounds.
July 30	Tasseled	58.28	9.06	122.23
August 9	Silked	300.41	110.80	491.25
August 21	In milk	664.98	129.00	706.74
September 7	Glazed	720.20	95.06	1734.96
September 23	Ripe	538.42	148.86	2852.86

The total starch per acre increased more than twenty-three times between tasseling of corn and harvesting, a period of fifty-five days. From the stage of glazing of corn until full ripening the increase in dry matter was 716 pounds, the increase in nitrogen-free extract, 587 pounds, while the increase of sugar and starch was 989 pounds, or greater by 273 pounds than the entire gain in crop. That is, much of the nitrogen-free extract which at period of glazing of corn was in the transitory state had been translocated and transformed into sugars and starch.

The conclusions reached last year with B. & W. corn are in the main borne out by the present season's investigation, and the results of two years' work given in a short summary are as follows:

CONCLUSIONS.

1. That the greatest weight of green fodder is between the period of full silking and milky stage of kernel.

2. That the total weight diminished after this date but the total dry matter increased.

3. That as the corn approaches maturity the per cent of amide nitrogen diminishes, while the albuminoid nitrogen increases, thus seemingly increasing the feeding value of the crop.

4. That the sugars and starch increase rapidly during the latter period of growth and maturing of the corn plant, and that these are the most valuable portion of the nitrogen-free extract.

5. That between the period of glazing and full ripening of corn there was a large increase in amount of sugar and starch.

6. That for the greatest amount of nutriment, considered from a chemical standpoint, corn should not be cut before it has well ripened.

7. That the B. & W. corn can not, in ordinary culture, be matured in this latitude.

DIGESTIBLE MATTER.

On this point at this date it is impossible for us to give definite information since our experiments in this line are not yet completed. Two silos have been filled, one with B. & W. corn at watery stage of kernels, the other with King Philip corn fully ripe. At a later date these will both be opened, the silage analyzed and digestion experiments made. A second lot of King Philip corn from same lot as put in silo was left for field curing and a third lot was put in barn-loft for curing. These will be carefully analyzed and their digestibility determined. When these experiments are completed, we hope to have data which will more fully answer the question as to total available nutrients of the corns.

Artificial digestion serves to give us a pretty definite knowledge of the digestibility of the albuminoids of foods and by this means we find that for the several cuttings we have:

	Total albuminoids. Lbs.	Albuminoids digestible. Lbs.
Tasseled	239.77	117.37
Silked	436.76	205.79
In milk	478.69	207.03
Glazed	643.86	315.42
Ripe	677.78	326.21

An inspection of the above table shows two periods of rapid increase in digestible albuminoids. These figures correspond with the periods of similar increase in total albuminoids. Between the period of the corn silking and the kernels in milk there is almost no increase in albuminoids, and the same is true between the glazing and ripening period of the corn although a rapid increase of starch is made.

CATTLE FOODS AND FEEDING RATIONS.

With the aid of Mr. Whalen, assistant chemist, Bulletin No. 17 was prepared for publication, and as much careful labor was put upon the work, the Bulletin contains matter for reference worthy of a permanent place in the annual report, and is reproduced with few slight changes.

INTRODUCTORY.

No question in the range of agricultural subjects discussed is awakening more interest among New York's 350,000 farmers than the subject of cattle foods and their economical use in feeding rations for the production of milk and its products, butter and cheese. This being true, it is believed that the information derived from scientific investigation, along with the practical experience of New York cattle feeders, will be welcomed by our dairymen as one advance step towards successful dairying.

New York State has one and a half million milch cows, probably producing on an average less than 3,000 pounds of milk per year, and the average annual butter product per cow for the State is undoubtedly less than 130 pounds. This should not be when there are whole herds averaging 300 and some 400 pounds of butter per year for each cow. Animals producing these by no means phenomenal yields, are not confined to any particular breed and are often grades of our so-called native or no breed animals. Proper selection, systematic breeding and judicious feeding have produced these profitable animals and herds. What has been accomplished by the few should be striven for by the many and feed must be a prime factor in developing the ideal dairy animal or herd. Careful breeding and selection must hold the most prominent place, but breeding and selection unless accompanied by good care and judicious feeding will ultimately result in failure.

In the following pages are brought together tables, with proper explanation, showing the composition of cattle foods; the digestibility of such foods; the amount digested from various foods in general use and finally are given several feeding rations together with those rations fed by a few of the farmers in different parts of the State.

CHEMICAL COMPOSITION OF CATTLE FOODS.

Terms used. For the full explanation of terms used we must refer the reader to Bulletin No. 14, New Series, or the annual report for 1888, page 235, where these have been fully explained. As guides, if the reader will remember in the expression of fodder analyses that albuminoids, protein and nitrogenous matter are all the same, and when he reads these terms think of lean meat, the white of an egg and gluten, the gummy part of wheat, then he will know what these products are like. Whenever the term fiber occurs think of paper as a good illustration. Remember that nitrogen-free extract and carbonaceous matter are the same, and sugar and starch are the purest forms.

In table A is given the chemical composition of a large number of food stuffs as analyzed at this Station.

The great variety given in table A includes the most of the foods with which the farmers of New York State have to do. These tables represent the per cent, or may be taken as the number of pounds of each 100 pounds of the food. To illustrate, take the first, Timothy grass; the table means that in 100 pounds of this green grass there were found $57\frac{31}{100}$ pounds of water, $2\frac{8}{100}$ pounds of ash, $3\frac{23}{100}$ pounds of albuminoids and the same for all the other parts.

TABLE A'.

Chemical composition of foods.

GRASSES, CLOVER, ETC., IN BLOOM.	Water.	Ash.	Albuminoids, N x 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Timothy, 1887	57.31	2.08	3.23	13.38	22.64	1.36
Timothy, 1888	67.09	1.41	2.50	11.54	16.36	1.10
Timothy, seed formed	48.14	2.25	3.28	18.16	26.72	1.45
Orchard grass	71.48	2.14	2.65	10.23	12.29	1.21
Kentucky blue or June grass	58.76	2.03	3.18	13.29	21.27	1.47
Meadow fescue	68.70	1.97	2.44	10.93	14.82	1.14
Tall meadow oat	69.46	1,73	2.60	10.63	14.38	1.20
Meadow foxtail	72.63	1.71	3.12	8.66	12.72	1.16
Fort Bellingham	62.58	2.35	3.33	12.49	17.96	1.29
Wood meadow grass	55.55	2.16	2.86	16.29	21.82	1.32
Bennett's native wild	57.62	1.88	3.31	16.30	19.44	1.45
Sweet vernal grass	67.41	1.57	2.10	10.74	17.02	1.16
Ox-eye daisies	78.46	1.59	1.28	5.62	12.16	.89
Buttercups	79.20	1.45	1.56	6.24	10.56	.99
Medium red clover	68.34	2.05	4.51	9.77	14.03	1.30
Alsike clover	77.29	1.95	3.66	5.32	10.76	1.02
White clover	78.23	1.79	4.42	4.70	9.44	1.42
Bokhara clover	69.20	1.61	3.52	13.12	11.45	1.10
Lucerne or alfalfa	67.46	2.95	5.91	10.51	12.02	1.15
Yellow trefoil	78.52	1.37	3.40	6.31	9.29	1.11
Chess or cheat	60.35	1.85	3.17	13.05	20.46	1.12
FORAGE PLANTS.						
Sorghum, average of three	84.00	.77	.97	5.23	8.60	.43
Sorghum, amber cane	82.44	.74	1.17	5.94	9.32	.39
Fodder corn	80.65	.99	1.54	6.10	10.14	.58
Ensilage, maize fodder	84.14	.96	1.00	5.14	7.92	.84
Ensilage, maize stover	59.29	1.72	3.62	8.11	24.80	2.46
Ensilage, Hungarian grass	60.51	2.75	3.30	13.60	17.51	2.33
Cow pea	84.06	1.83	3.12	3.48	6.91	.60
Soja hispida	69.87	2.38	3.34	8.36	14.90	1.15
Prickly comfrey	84.36	2.45	2.94	2.61	7.13	.51
Rye forage	79.04	1.47	2.85	7.77	7.82	1.05
Oat and pea forage	74.81	1.66	3.97	7.98	10.32	1.26
Hungarian grass	73.49	1.72	3.45	7.81	12.43	1.10

Table A — *Chemical composition of foods* — (Concluded).

ROOTS, TUBERS, ETC.	Water.	Ash.	Abuminoids. Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Sweet potatoes	74.38	1.34	3.56	2.14	17.98	.60
Potatoes	78.49	.84	2.42	.68	17.51	.06
Cabbage, outer leaves	89.86	1.35	1.83	2.98	3.51	.47
Turnips	92.40	.72	1.25	1.20	4.20	.23
Pumpkins	92.27	.63	1.11	1.49	4.34	.16
Mangolds	94.41	1.09	1.03	1.00	2.40	.07
Carrots	91.13	1.00	1.08	1.41	5.09	.29
Okra	87.41	.74	1.99	3.42	6.04	.40
Onion	89.26	.45	1.09	.65	8.31	.24
Tomatoes	91.26	.73	1.00	.70	5.84	.47
String beans	83.46	.83	2.75	2.58	10.04	.34
Apples, sweet	77.30	.46	.50	1.27	19.96	.41
HAYS.						
Timothy, in bloom	15.35	4.16	6.59	26.88	44.33	2.69
Timothy, in seed	15.35	3.65	5.34	29.65	43.65	2.36
Orchard grass	15.35	6.13	8.12	31.14	35.73	3.53
Mixed hays	14.80	4.92	6 37	32.30	39.15	2.46
Red clover, in bloom	15.35	5.50	12.05	25.99	37.63	3.48
Alsike clover	15.35	6.55	11.44	24.95	38.37	3.34
Clover rowen	14.33	6.23	11.08	28.80	36.36	3.20
Lucerne or alfalfa	15.02	6.69	13.81	27.28	34.97	2.26
STRAW.						
Wheat straw	17.86	4.16	2.98	42.74	31.04	1.22
Oat straw	16.28	4.83	2.35	36.77	37.97	1.80
Maize stover (field cured)	49.01	3.62	3.25	18.78	24.13	1.21
Maize stover (in barn)	22.63	5.35	6.47	28.43	35.87	1.25
Soja bean fodder	21.23	8.37	8.42	22.34	38.29	1.35
GRAIN, MEAL, ETC.						
Corn	10.54	1.57	10.86	2.31	69.21	5.51
Corn meal	17.08	1.30	8.80	1.74	67.26	3.82
Wheat, winter	13.31	1.57	11.81	3.11	68.57	1.63
Wheat flour	13.26	.38	10.50	1.21	73.62	1.03
Oats	12.28	2.98	12.19	13.58	54.18	4.79
Pea meal	12.08	2.61	21.37	11.06	52.02	.86
Beans	12.39	3.71	22.17	7.21	53.14	1.38
Sunflower seed	12.68	3.00	15.88	29.21	18.71	20.52
BY-PRODUCTS.						
Wheat bran	13.71	5.53	14.56	10.83	52.26	3.11
Ship stuff	14.75	5.27	16.38	6.36	52.66	4.58
Middlings	12.41	3.61	15.62	4.22	59.66	4.48
Brewers' grains	76.60	.94	4.82	3.82	12.53	1.29
Corn feed (starch feed, etc.)	65.40	.21	5.96	3.41	21.51	3.51
Corn feed (dry)	6.00	.72	16.04	13.02	58.14	6.08
Gluten meal	10.49	.74	21.39	5.62	54.87	6.89
Linseed meal	9.83	5.13	31.52	11.54	34.95	7.03
Cotton-seed meal	11.06	7.39	40.56	3.56	23.86	13.57
Hominy feed	12.06	2.61	11.56	5.02	63.31	5.44
Buckwheat hulls	7.50	1.96	4.86	50.71	34.13	.84
Rye bran	10.58	4.46	15.87	5.06	60.14	3.89
Palm nut meal	8.23	3.53	16.29	25.79	33.34	18.82
MISCELLANEOUS.						
Castor pomace (dry)	......	6.36	35.00	31.06	10.76	16.82
Dandelion	92.35	1.18	1.83	1.14	3.04	.46
Pie-plant	97.06	.48	.62	.65	1.10	.09
Mushrooms	89.15	.85	6.08	.76	2.37	.79
Plaintains	80.84	2.79	2.10	3.09	10.56	.62
Canada thistle	75.39	2.40	2.05	7.28	11.20	1.68
Peanut meal	4.21	2.41	27.37	3.62	25.83	36.56
Peanut shuck	6.06	2.77	12.81	53.26	18.39	6.71
Peanut vine	6.25	5.64	12.65	27.34	34.00	14.12
Corn cob*	21.55	1.55	1.22	31.60	43.38	.24

* As harvested.

AMERICAN DIGESTION EXPERIMENTS.

There have already been made in America about forty digestion experiments, but as the results are inaccessible to nearly all, I have brought together in Table B all those which have come under my observation. This is a good beginning, and it is gratifying to see the manifest desire on the part of feeders for more information on this subject. In the future it is hoped more attention will be given by investigators, to determining the digestibility of rations such as are being fed in practice by our most progressive feeders.

As is well known, not all of the food eaten by an animal is digested, and the figures, called coefficients of digestibility, given in Table B, mean that the per cent indicated may be expected to be digested. For the benefit of feeders I have made the calculations and given the results in Table C and following tables, so that Table B is more for reference in future work.

TABLE B.

Coefficients of digestibility.

FOOD.	Dry substance.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	Determination made by.
Timothy	65.7	60.4	62.1	71.8	51.5	Jordan.
Timothy	54.1	55.5	51.7	61.0	34.6	Jordan.
Timothy	....	42.1	52.0	65.7	47.6	Jordan.
Timothy	51.6	45.2	42.8	58.9	55.0	Jordan.
Orchard grass	60.0	60.0	66.7	57.3	57.4	N. Y. Exp. Station.
Orchard grass	57.5	60.9	60.0	55.3	55.4	N. Y. Exp. Station.
Orchard grass	54.4	58.5	57.5	54.4	51.2	Jordan.
Red top	57.6	60.4	61.2	59.1	44.2	Jordan.
Witch grass	59.9	64.2	67.6	62.1	60.0	Jordan.
Wild oat grass	59.6	48.6	65.1	62.1	38.2	Jordan.
Blue joint	39.9	56.5	36.5	43.2	37 0	Jordan.
Mixed hay	....	49.0	49.0	58.0	50.0	Sturtevant.
Mixed hay	54.3	46.9	46.8	55.8	50.0	N. Y. Exp. Station.
Clover hay (red)	51.7	49.4	47.5	57.6	42.6	Armsby.
Alfalfa hay	59.4	68.8	43.3	71.8	48.4	N. Y. Exp. Station.
Alfalfa hay	....	77.0	49.0	64.0	54.0	O'Brine.
Alsike clover	61.9	64.0	51.0	74.1	35.1	Jordan.
Alsike clover	54.9	55.5	46.2	64.1	53.2	Jordan.
White clover	66.0	73.2	60.6	69.5	50.6	Jordan.
Buttercup	56.1	56.3	41.1	66.9	69.7	Jordan.
White weed	57.8	58.4	45.5	66.7	62.0	Jordan.
Oat straw	50.3	?	57.6	53.2	38.3	Jordan.
Maize fodder	....	78.0	70.0	53.0	52.0	Woll.
Maize fodder	....	49.0	67.0	61.0	73.0	Sturtevant.
Maize stover	62.0	52.0	66.0	64.0	52.0	Armsby.
Maize ensilage	....	49.0	69.0	67.0	90.0	Sturtevant.
Maize ensilage	....	78.0	74.0	56.0	73.0	Woll.
Soja bean fodder	....	70.0	58.0	82.0	54.0	Sturtevant.
Rye hay	73.6	79.1	79.6	70.6	74.2	Frear.
Malt sprouts	67.4	80.3	33.8	68.6	100.0	Armsby.
Cotton-seed meal	80.8	88.2	0	67.3	100.0	Armsby.
Corn meal	86.7	56.9	?	85.2	87.0	N. Y. Exp. Station.
Corn meal	82.6	59.7	?	89.1	96.9	N. Y. Exp. Station.
Corn meal	89.5	86.1	29.4	94.2	81.7	Jordan.
Corn and cob meal	76.6	75.7	28.5	83.6	82.0	Jordan.
Whole corn	82.5	68.7	38.3	88.8	45.6	Jordan.
Potatoes	77.0	44.2	?	90.9	13.0	Jordan.

PER CENT OF DIGESTIBLE MATTER IN CATTLE FOODS.

The chemical composition of foods was given in Table A, and in Table B their digestibility, as determined by American investigations. In Table C is shown the actual amount of these various foods digested by animals. I have used American figures so far as we have them, and drawn from the German tables for the others as given in Armsby's Manual of Cattle Feeding.

Table C shows the per cent, or pounds of digestible matter in 100 pounds of the various foods. As an illustration let us take under meals, corn meal. We find that in 100 pounds of the average corn meal there are 72.14 pounds of dry matter, six and thirty-five one-hundredths (6.35) pounds of albuminoids, and so on with any other food.

From Table C it will be an easy matter to estimate pretty closely the amount of digestible matter eaten per day by animals, if we know the amount of food they have eaten. Let us suppose that a cow is eating fifteen pounds of red clover hay each day. In table C find under hay, red clover. Multiply each set of figures given for red clover by the amount of hay eaten and we at once have the amount of digestible albuminoids, etc., eaten as follows:

	Clover eaten.	Digestible matter eaten. Pounds.
Dry matter	43.76×15	6.56
Albuminoids	5.95×15	.89
Crude fiber	12.36×15	1.85
Nitrogen-free extract	21.67×15	3.25
Fat	1.48×15	.22

In just the same way from this table can we estimate pretty closely the amount of digestible matter that is eaten by any animal if we only know the pounds of food fed each day.

TABLE C.

Showing per cent digestible matter.

GRASSES, ETC.	Dry matter.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	Nutritive ratio.
Timothy (in bloom)	18.33	1.22	5.75	10.26	.54	1: 14.2
Timothy (seed formed)	28.88	1.60	9.06	16.75	.71	1: 10.9
Orchard grass	16.11	1.56	6.19	6.79	.65	1: 9.4
Kentucky Blue	23.65	1.92	8.13	12.57	.65	1: 11.1
Medium red clover	16.37	2.23	4.64	8.08	.55	1: 6.3
Alsike clover	12.87	2.11	2.52	7.17	.50	1: 5.1
Lucerne	19.32	4.06	4.55	8.63	.56	1: 3.6
FORAGE PLANTS.						
Sorghum,* average of three	....	.60	3.14	6.71	.37	1: 17.9
Sorghum, Amber*	....	.73	3.56	7.17	.33	1: 15.9
Ensilage, Maize fodder	....	.49	3.54	4.90	.76	1: 21.2
Ensilage, Maize stover	....	1.77	5.60	16.61	2.21	1: 15.7
Fodder corn	... .	1.12	4.39	6.79	.44	1: 19.7
ROOTS, TUBERS, ETC.						
Potatoes	16.56	1.07	?	15.91	.08	1: 15 6
Cabbage leaves* (outer)	....	1.30	......	3.51 (?)	.28	1: 3.3
HAY.						
Timothy (in bloom)	47.15	3.21	13.38	27.79	1.32	1: 13.9
Timothy (seed formed)	47.15	2.60	14.76	26.37	1.16	1: 16.9
Orchard grass	47.83	5.28	18.53	19.66	1.90	1: 8.1
Mixed hays	46.26	3.05	15.47	22.47	1.23	1: 13.4
Red clover	43.76	5.95	12.36	21.67	1.48	1: 6.3
Alsike clover	48.00	6.59	11.82	25.55	1.62	1: 6.3
STRAW.						
Wheat straw*	....	.77	22.22	12.42	.33	1: 46.0
Oat straw	42.11	.42	21.18	20.20	.69	1: 102.3
Maize stover (field cured)	31.61	1.64	12.49	15.08	.76	1: 17.9
Maize stover (barn cured)	47.97	3.26	18.91	22.42	.78	1: 13.3
GRAINS, MEAL, ETC.						
Corn meal	72.14	6.35	.51	60.94	3.30	1: 10.9
Oats*	....	9.02	2.85	39.48	3.93	1: 5.8
Pea meal*	....	18.81	8.18	50.46	.50	1: 3.2
BY-PRODUCTS.						
Wheat bran	....	12.81	2.17	41.81	2.49	1: 3.9
Brewer's grain	....	4.10	......	12.53 (?)	1.03	1: 3.6
Corn feed (fresh)	30.10	4.30	1.00	19.47	3.03	1: 6.5
Corn feed (dry)	81.78	11.58	3.83	53.62	5.25	1: 6.1
Linseed meal	....	27.42	3.00	31.80	6.40	1: 1.9
Cotton-seed meal	71.86	35.77	.0	16.06	13.57	1: 1.4

* The digestion coefficient for the foods marked with a star are from the German tables

AMOUNT OF DIGESTIBLE MATTER IN CATTLE FOODS.

The great interest manifested by the farmers of New York State in all questions of feeding has led me to calculate the amount of digestible matter in our more common foods. By referring to Table D we can find all calculated the amount of digestible matter in one pound, five pounds, twenty pounds, twenty-five pounds, and 2,000 pounds of the various coarse fodders; in the grains, meals, etc., the amounts are given up to as much as will be likely to be fed per day. The reader will notice in Table

D that the term crude fiber and nitrogen-free extract do not appear, but in place of those we have carbohydrates. Carbohydrates includes the crude fiber and nitrogen-free extract, and as aids to memory let the reader bear in mind that sugars and starch in foods are the purest forms of carbohydrates. From this table (D) it will be an easy matter for any farmer to get a pretty fair estimate of the amount of digestible matter eaten by his animals. These figures must not be followed too closely, for no two foods will be just the same in composition nor two animals will be found just alike in their ability to digest and assimilate food. They are intended simply as guides to the thinking farmer.

As an example to aid, let us assume a case of feeding a milch cow of 1,000 pounds live weight. A farmer finds his cow is eating per day about as follows:

	Pounds.
Clover hay	15
Maize ensilage	25
Corn meal	5
Wheat bran	3

By referring in Table D to hay, ensilage, corn meal and wheat bran, we can find the amounts of digestible matter in one day's feed or ration as follows:

	Albuminoids.	Carbohydrates.	Fat.
Clover hay	.89	5.10	.22
Ensilage	.12	2.11	.19
Corn meal	.32	3.07	.16
Wheat bran	.38	1.32	.07
	1.71	11.60	.64

Thus we find that the animal was receiving per day, of digestible albuminoids, 1.71 pounds, carbohydrates, 11.60 pounds, and fat, 0.64 pounds. A little later we shall see that according to German standards this ration is not properly balanced for the best results in milk and butter production. With very little difficulty anyone should be able from these tables to estimate pretty closely the amounts eaten by his animals, and then one will be in a way to judge which way to vary the feeding.

TABLE D.

Amount of digestible matter.

GRASSES, ETC.	Weight.	Dry matter.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Timothy (in bloom)	1	.183	.0122	.160	.005
	5	.917	.061	.800	.027
	10	1.833	.122	1.601	.054
	15	2.749	.183	2.401	.081
	20	3.666	.244	3.202	.108
	25	4.582	.305	4.002	.135
	2,000	366.6	24.40	320.2	10.80
Timothy (seed formed)	1	.288	.016	.258	.007
	5	1.444	.080	1.290	.035
	10	2.888	.160	2.581	.071
	15	4.332	.240	3.871	.106
	20	5.776	.320	5.162	.142
	25	7.220	.400	6.452	.177
	2,000	576.00	32.00	516.20	14.20
Orchard grass	1	.161	.015	.129	.006
	5	.805	.078	.649	.032
	10	1.611	.156	1.298	.065
	15	2.416	.234	1.947	.097
	20	3.222	.312	2.596	.130
	25	4.027	.390	3.245	.162
	2,000	322.20	31.20	259.60	13.00
Kentucky Blue grass	1	.236	.019	.207	.006
	5	1.182	.096	1.035	.032
	10	2.365	.192	2.070	.065
	15	3.547	.288	3.105	.097
	20	4.730	.384	4.140	.130
	25	5.912	.480	5.175	.162
	2,000	473.00	38.40	414.00	13.00
Medium red clover	1	.164	.022	.127	.005
	5	.818	.111	.636	.027
	10	1.637	.223	1.272	.055
	15	2.455	.334	1.908	.082
	20	3.274	.446	2.544	.110
	25	4.092	.557	3.180	.137
	2,000	327.40	44.60	254.40	11.00
Alsike clover	1	.128	.021	.097	.005
	5	.643	.105	.484	.025
	10	1.287	.211	.969	.050
	15	1.930	.316	1.453	.075
	20	2.574	.422	1.938	.100
	25	3.217	.527	2.422	.175
	2,000	257.40	42.20	193.80	10.00
Lucerne or Alfalfa	1	.193	.041	.132	.006
	5	.966	.203	.659	.028
	10	1.932	.406	1.318	.056
	15	2.898	.609	1.977	.084
	20	3.864	.812	2.636	.112
	25	4.830	1.015	3.295	.140
	2,000	386.40	81.20	263.60	11.20
FORAGE PLANTS.					
Sorghum (average 3)	1	....	.006	.098	.004
	5	....	.030	.492	.018
	10	....	.060	.985	.037
	15	....	.090	1.477	.055
	20	....	.120	1.970	.074
	25	....	.140	2.462	.092
	2,000	....	12.00	197.00	7.40
Sorghum (Early Amber)	1	....	.007	.107	.003
	5	....	.036	.536	.016
	10	....	.073	1.073	.033
	15	....	.109	1.609	.049
	20	....	.146	2.146	.066
	25	....	.182	2.682	.082
	2,000	....	14.60	214.60	6.60
Fodder corn	1	....	.011	.112	.004
	5	....	.056	.559	.022
	10	....	.112	1.118	.044
	15	....	.167	1.677	.066
	20	....	.224	2.236	.088
	25	....	.280	2.795	.110
	2,000	....	22.40	223.60	8.80
Ensilage (maize fodder)	1	....	.005	.084	.008
	5	....	.024	.422	.038
	10	....	.049	.844	.076

TABLE D — *Amount of digestible matter* — (Continued).

GRASSES, ETC.	Weight.	Dry matter.	Albuminoids.	Carbohydrates.	Fat.
FORAGE PLANTS — (*Concluded*).	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Ensilage (maize fodder)	15	....	.073	1.266	.114
	20	....	.098	1.688	.152
	25	....	.122	2.110	.190
	2,000	....	9.80	168.80	15.20
Ensilage (maize stover)	1	....	.018	.222	.022
	5	....	.088	1.110	.110
	10	....	.177	2.221	.221
	15	....	.265	3.331	.331
	20	....	.354	4.442	.442
	25	....	.442	5.552	.552
	2,000	....	35.40	444.00	44.20
HAY.					
Timothy (bloom)	....	.4715	.032	.412	.013
	1	2.357	.160	2.058	.066
	5	4.715	.321	4.117	.132
	15	7.072	.481	6.175	.198
	20	9.430	.642	8.234	.264
	25	11.787	.802	10.292	.330
	2,000	943.00	64.20	823.40	26.40
Timothy (seed formed)	1	.4715	.026	.411	.012
	5	2.357	.130	2.056	.058
	10	4.715	.260	4.113	.116
	15	7.072	.390	6.196	.174
	20	9.430	.520	8.226	.232
	25	11.787	.650	10.282	.290
	2,000	943.00	52.00	822.60	23.20
Orchard grass	1	.4783	.053	.382	.019
	5	2.391	.264	1.909	.095
	10	4.783	.528	3.819	.190
	15	7.174	.792	5.728	.285
	20	9.566	1.056	7.638	.380
	25	11.957	1.320	9.547	.475
	2,000	956.60	105.60	763.80	38.00
Mixed hays	1	.463	.030	.379	.012
	5	2.313	.152	1.897	.061
	10	4.626	.305	3.794	.123
	15	6.939	.457	5.691	.184
	20	9.252	.610	7.588	.246
	25	11.565	.762	9.485	.307
	2,000	925.20	61.00	758.80	24.60
Red clover	1	.438	.06	.340	.015
	5	2.188	.297	1.170	.074
	10	4.376	.595	3.403	.148
	15	6.564	.892	5.103	.222
	20	8.752	1.190	6.806	.296
	25	10.940	1.487	8.506	.370
	2,000	875.20	131.80	680.60	29.60
Alsike clover	1	.48	.066	.374	.016
	5	2.40	.329	1.868	.081
	10	4.80	.659	3.737	.162
	15	7.20	.988	5.605	.243
	20	9.60	1.318	7.474	.324
	25	12.00	1.647	9.342	.405
	2,000	960.00	119.00	747.40	32.40
STRAW.					
Wheat straw	1	....	.008	.346	.003
	5	....	.038	1.732	.016
	10	....	.077	3.464	.033
	15	....	.115	5.196	.049
	20	....	.154	6.928	.066
	25	....	.192	8.660	.082
	2,000	....	15.40	692.80	6.60
Oat straw	1	.421	.004	.414	.007
	5	2.105	.021	2.069	.034
	10	4.211	.042	4.138	.069
	15	6.316	.063	6.207	.103
	20	8.422	.084	8.276	.138
	25	10.527	.105	10.345	.172
	2.000	842.20	8.40	827.60	13.80
Maize stover (field)	1	.316	.016	.276	.008
	5	1.580	.082	1.378	.038
	10	3.161	.164	2.757	.076
	15	4.741	.246	4.135	.114
	20	6.322	.328	5.514	.152
	25	7.902	.410	6.892	.190
	2,000	632.20	32.80	551.40	15.20
Maize stover (barn)	1	.48	.033	.483	.008

TABLE D—*Amount of digestible matter*—(Concluded).

GRASSES. ETC.	Weight.	Dry matter.	Albuminoids.	Carbohydrates.	Fat.
STRAW—(*Continued*).	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Maize stover (barn)	5	2.398	.163	2.416	.039
	10	4.797	.326	4.833	.078
	15	7.195	.489	7.249	.117
	20	9.594	.652	9.666	.156
	25	11.992	.815	12.082	.195
	2,000	959.40	65.20	966.60	15.60
GRAINS, MEALS, ETC.					
Corn meal........................	1	.721	.063	.614	.033
	3	2.164	.190	1.843	.099
	5	3.607	.317	3.072	.165
	8	5.771	.508	4.916	.264
	10	7.214	.635	6.145	.330
	12	8.657	.762	7.374	.396
Oats	1	....	.090	.423	.039
	3	....	.270	1.270	.118
	5	....	.451	2.116	.196
	8	....	.722	3.386	.314
	10	....	.902	4.233	.393
	12	....	1.082	5.079	.472
Pea meal.........................	1	....	.188	.586	.005
	3	....	.564	1.759	.015
	5	....	.940	2.932	.025
	8	....	1.505	4.691	.040
	10	....	1.881	5.864	.050
	12	....	2.227	7.037	.060
ROOTS, TUBERS, ETC.					
Potatoes	10	1.656	.107	1.501?	.008
	15	2.484	.160	2.386	.012
	20	3.312	.214	3.182	.016
Cabbage leaves..................	10	....	.13	.357	.028
	15	....	.19	.526	.042
	20	....	.26	.702	.056
BY-PRODUCTS.					
Wheat bran......................	1	....	.128	.44	.025
	3	....	.384	1.319	.075
	5	....	.640	2.199	.124
	8	....	1.015	3.508	.199
	10	....	1.281	4.398	.249
	12	....	1.537	5.278	.299
Middlings........................	1	....	.145	.497	.036
	3	....	.435	1.490	.109
	5	....	.725	2.483	.181
	8	....	1.162	3.974	.290
	10	....	1.453	4.967	.363
	12	....	1.744	5.960	.436
Brewers' grain	1	....	.041	.125	.010
	3	....	.123	.376	.031
	5	....	.205	.626	.051
	8	....	.328	1.002	.082
	10	....	.410	1.253	.103
	12	....	.492	1.504	1.236
Linseed meal.....................	1	....	.274	.348	.064
	3	....	.823	1.044	.192
	5	....	1.371	1.740	.320
	8	....	2.194	2.784	.512
	10	....	2.742	3.480	.640
	12	....	3.290	4.176	.768
Cotton-seed meal................	1	.719	.358	.161	.136
	3	2.156	1.073	.481	.407
	5	3.593	1.788	.803	.678
	8	5.749	2.862	1.285	1.085
	10	7.186	3.577	1.606	1.357
	12	8.623	4.292	1.927	1.628
Corn feed (fresh)	1	.301	.043	.205	.030
	3	.903	.129	.614	.091
	5	1.505	.215	1.023	.151
	8	2.408	.344	1.638	.242
	10	3.010	.430	2.047	.303
	12	3.311	.516	2.456	.364
Corn feed (dry)....................	1	.818	.116	.574	.052
	3	2.454	.348	1.723	.157
	5	4.090	.579	2.872	.262
	8	6.544	.926	4.596	.420
	10	8.178	1.158	5.745	.525
	12	9.814	1.390	6.894	.590

FEEDING STANDARDS.

How much food per day does the different classes of animals require? This question is the first asked by the interested reader. According to the German standards as given in Armsby's Manual of Cattle Feeding, the quantity of food and the relation between the nitrogenous and carbonaceous matter of the foods have been pretty well worked out by German investigators. In America there is a difference of opinion and the tendency is to lower the standards, but the principle involved will stand the test of investigation while the details will be modified to suit our climate, food and animals. Until sufficient data has been accumulated to enable American investigators to determine the amount of variation, we may safely use the German results as guides.

In the table following are given the amount of organic matter and the digestible albuminoids, carbohydrates and fat required for an animal of 1,000 pounds weight.

TABLE E.

Pounds per day for 1,000 *pounds live weight.*

	ORGANIC SUBSTANCE.				
	Organic matter.	Albuminoids.	Carbohydrates.	Fat.	Nutritive ratio.
	Pounds.	Pounds.	Pounds.	Pounds.	
Oxen at rest	17.5	.7	8.0	.15	1:12.0
Sheep, coarse breeds	20.0	1.2	10.3	.20	1: 9.0
Sheep, fine breeds	22.5	1.5	11.4	.25	1: 8.0
Oxen, moderately worked	24.0	1.6	11.3	.30	1: 7.5
Oxen, heavily worked	26.0	2.4	13.2	.50	1: 6.0
Horses, moderately worked	22.5	1.8	11.2	.60	1: 7.0
Horses, heavily worked	25.5	2.8	13.4	.80	1: 5.5
Milch cows	24.0	2.5	12.5	.40	1: 5.4
Fattening oxen, first period	27.0	2.5	15.0	.50	1: 6.5
Fattening oxen, second period	26.0	3.0	14.8	.70	1: 5.5
Fattening oxen, third period	25.0	2.7	14.8	.60	1: 6.0
Fattening sheep, first period	26.0	3.0	15.2	.50	1: 5.5
Fattening sheep, second period	25.0	3.5	14.4	.60	1: 4.5
GROWING CATTLE. Age. months. — Average live weight per head.					
2-3 — 150 pounds	22.0	4.0	13.8	2.0	1: 4.7
3-6 — 300 pounds	23.4	3.2	13.5	1.0	1: 5.0
6-12 — 500 pounds	24.0	2.5	13.5	.6	1: 6.0
12-18 — 700 pounds	24.0	2.0	13.0	.4	1: 7.0
18-24 — 850 pounds	24.0	1.6	12.0	.3	1: 8.0
Fattening swine, first period	36.0	5.0	27.5		1: 5.5
Fattening swine, second period	31.0	4.0	24.0		1: 6.0
Fattening swine, third period	23.5	2.7	17.5		1: 6.5

FEEDING RATIONS.

In the previous tables are given the data in the most available form for calculating rations* and for estimating the amount of digestible matter consumed per day by our farm animals. Nineteen rations have been selected such as may be fed and often are fed by farmers, and regardless of their nature have calculated the amount of digestible matter for such rations, given the nutritive ratio, the cost per day for the ration, also the value of the fertilizing matter contained in the ration. Not all of the fertilizing matter contained in such a ration will be recovered again in the dung and urine, a portion being retained by the animal. In the case of milch cows probably about eighty per cent of the fertilizing matter will be found in the voidings. In calculating the cost of rations the prices per ton for foods as given below have been used. The prices given for grain and meals are what they cost in this locality for the winter of 1888:

Cost of Feeds.

	Per ton.	Per pound.
Bran (wheat)	$20.00	.01
Corn meal	20.00	.01
Linseed meal (O. P.)	26.50	.0133
Gluten meal	27.00	.135
Cotton-seed meal	26.00	.013
Middlings (wheat)	20.00	.01
Oats	25.00	.0125
Starch waste	20.00	.01
Roots	3.00	.0015
Ensilage (maize)	3.00	.0015
Hay, mixed grass	10.00	.005
Straw	5.00	.0025
Red clover	12.00	.006
Alfalfa hay	12.00	.006
Maize stover	6.00	.003

As will be observed, some of the rations following are nearly a "balanced ration" according to German standards, or guides, while others are far from being a well-proportioned mixture for milch cows. Rations 5, 6, 10, 12, 13, 17 and 19 may be considered very close to the standard and ration 3 is particularly strong in nitrogenous principles, while Rations 1 and 2 are by no means a butter ration, but not uncommonly fed.

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*A ration is the amount of food consumed by an animal in one day, or twenty-four hours.

Ration I.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds,	Pounds.
Hay	20	.61	7.59	.246
Corn meal	8	.51	4.92	.264
Total	....	1.13	12.51	.510

Nutritive ratio, 1 : 12.3.
Cost per day, 18 cents.
Value of fertilizing matter in ration, 7 cents.

Ration II.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	18	.54	6.82	.22
Corn meal	5	.32	3.07	.16
Wheat bran	5	.64	2.20	.12
Total	....	1.50	12.09	0.05

Nutritive ratio, 1 :8.8.
Cost per day, 19 cents.
Value of fertilizing matter in ration, 9 cents.

Ration III.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	18	.54	6.82	.22
Wheat bran	5	.64	2.22	.22
Linseed meal	5	1.37	1.74	.36
Total	....	2.25	10.76	.66

Nutritive ratio, 1 :5.5.
Cost per day, 20.6 cents.
Value of fertilizing matter in ration, 14 cents.

Ration IV.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	18	.54	6.82	.22
Wheat bran	5	.64	2.20	.12
Corn meal	3	.19	1.84	.10
Cotton-seed meal	2	.72	.32	.27
Total	……..	2.09	11.18	.71

Nutritive ratio, 1 : 6.2.
Cost per day, 19.6 cents.
Value of fertilizing matter in ration, 13 cents.

Ration V.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	20	.61	7.59	.246
Gluten meal	2	.31	1.03	.12
Wheat bran	5	.64	2.20	.12
Linseed meal	3	.82	1.04	.19
Total	……..	2.38	11.86	.68

Nutritive ratio, 1 : 5.7.
Cost per day, 21.7 cents.
Value of fertilizing matter in ration, 13 cents.

Ration VI.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds,	Pounds.
Hay, red clover	18	1.07	6.12	.27
Wheat bran	5	.64	2.20	.12
Corn meal	6	.38	3.69	.20
Linseed meal	1	.27	.35	.07
Total	…….	2.36	12.36	.66

Nutritive ratio, 1 : 5.9.
Cost per day, 21.3 cents.
Value of fertilizing matter in ration, 14 cents.

Ration VII.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	15	.46	5.69	.18
Wheat bran	5	.64	2.20	.12
Corn meal	5	.32	3.07	.16
Linseed meal	3	.82	1.04	.19
Total	....	2.24	12.00	.65

Nutritive ratio, 1 : 6.

Cost per day, 21.5 cents.,

Value of fertilizing matter in ration, 13 cents.

Ration VIII.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay, red clover	8	.48	2.72	.12
Wheat straw	5	.04	1.73	.02
Ensilage, maize	30	.15	2.52	.24
Wheat bran	4	.57	1.72	.10
Corn meal	3	.19	1.84	.10
Cotton-seed meal	2	.72	.32	.27
Total	....	2.09	10.85	.85

Nutritive ratio, 1 : 6.2.

Cost per day, 19.3 cents.

Value of fertilizing matter in ration, 12 cents.

Ration IX.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	10	.30	3.79	.12
Wheat bran	4	.57	1.76	.10
Linseed meal	4	1.10	1.39	.25
Maize stover	12	.40	5.80	.10
Total	....	2.31	12.74	.57

Nutritive ratio, 1 : 6.1.

Cost per day, 17.9 cents.

Value of fertilizing matter in ration, 12 cents.

Ration X.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	10	.30	3.79	.12
Oat straw	10	.04	4.14	.07
Linseed meal	4	1.10	1.39	.25
Wheat bran	5	.64	2.20	.12
Roots	15	.19	.81	.03
Total	....	2.27	12.33	.59

Nutritive ratio, 1 :6.
Cost per day, 20 cents.
Value of fertilizing matter in ration, 13 cents.

Ration XI.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Wheat straw	20	.15	6.93	.07
Maize ensilage	30	.15	2.52	.24
Cotton-seed meal	2½	.89	.40	.33
Linseed meal	1	.27	.35	.06
Wheat bran	4	.51	1.76	.10
Total	....	1.97	11.96	.80

Nutritive ratio, 1 :7.1.
Cost per day, 18 cents.
Value of fertilizing matter in ration, 11 cents.

Ration XII.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay, alfalfa	15	1.42	5.55	.16
Wheat bran	5	.64	2.20	.12
Corn meal	6	.38	3.68	.20
Total	....	2.44	11.43	.48

Nutritive ratio, 1 :5.2.
Cost per day, 20 cents.
Value of fertilizing matter in ration, 12 cents.

Ration XIII.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay, alfalfa	20	1.80	6.58	.22
Corn meal	10	.63	6.14	.33
Total	....	2 43	12.72	.55

Nutritive ratio, 1 :5.8.
Cost per day, 22 cents.
Value of fertilizing matter in ration, 12 cents.

Ration XIV.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	15	.46	5.69	.18
Oats	5	.45	2.12	.20
Linseed meal	3	.82	1.04	.20
Corn meal	5	.32	3.07	.16
Total	....	2.05	11.92	.74

Nutritive ratio, 1 :6.2.
Cost per day, 22.7 cents.
Value of fertilizing matter in ration, 11 cents.

Ration XV.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Maize stover	20	.65	9.67	.16
Wheat bran	3	.38	1.32	.07
Linseed meal	4	1.10	1.39	.25
Roots	12	.15	.65	.03
Total	....	2.28	13.03	.51

Nutritive ratio, 1 : 6.3.
Cost per day, 16.1 cents.
Value of fertilizing matter in ration, 10 cents.

Ration XVI.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Maize stover	13	.42	6.28	.10
Ensilage	25	.12	2.11	.19
Cotton-seed meal	2	.72	.32	.27
Wheat bran	5	.64	2.20	.12
Starch waste (dry)	4	.23	1.15	.10
Total	... .	2.13	12.06	.78

Nutritive ratio, 1 : 6.6.
Cost per day, 19.2 cents.
Value of fertilizing matter in ration, 11 cents.

Ration XVII.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	20	.61	7.59	.25
Wheat bran	5	.64	2.20	.12
Roots	15	.19	.81	.03
Cotton-seed meal	3	1.07	.48	.40
Total	....	2.13	10.98	.80

Nutritive ratio, 1 : 5.2.
Cost per day, 22.4 cents.
Value of fertilizing matter in ration, 14 cents.

Ration XVIII.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Alfalfa hay	25	2.26	8.95	.27

Nutritive ratio, 1 : 4.3.
Cost per day, 15 cents.
Value of fertilizing matter in ration, 11 cents.

Ration XIX.

	Weight.	Albuminoids.	Carbohydrates.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.
Hay	22	.67	8.34	.27
Wheat bran	4	.51	1.76	.10
Corn meal	2	.12	1.23	.07
Cotton-seed meal	3	1.07	.48	.40
Linseed meal	1	.27	.35	.07
Total	....	2.64	12.20	.91

Nutritive ratio, 1 : 5.48.

Cost per day, 22.2 cents.

Value of fertilizing matter in ration, 16 cents.

RATIONS FED BY NEW YORK FARMERS.

In December of 1888, a circular was sent to about fifty of the leading dairy farmers of New York State, asking for information regarding rations fed by them. A few only replied, and in some instances the data given was not sufficiently complete to enable us to judge correctly of the rations fed.

From the reports received we have given such notes as are of general interest, together with the ration, so that others may see what kind of rations are fed by some of the best known of our breeders and dairymen. It is to be regretted that so few of the dairymen throughout the State replied to the circular, but from such data as we have, enough is presented to show the influence of food when properly combined and judiciously fed to animals selected and bred for a purpose.

For each ration we have estimated approximately the amount of digestible matter, and given such brief comments as seem essential for a clear understanding. Briefly we may repeat that according to German standards a cow 1,000 pounds live weight, in full flow of milk, to do her best, should receive, of digestible matters, as follows:

	Pounds.
Albuminoids	2.5
Carbohydrates	12.5
Fat	.4
Nutritive ratio	1 : 5.4

American investigations and experience seem to indicate that equally as good results are secured with a somewhat wider nutritive ratio than that given by the Germans. Bearing these explanations in mind we may proceed to a consideration of the returns received.

No. 1. Rochester, N. Y.:

Cows in herd, 49; mostly Guernseys; average about six years old; average weight, 1,000 pounds, and cows go dry about six weeks.

Average milk yield in summer, 15 quarts.

Average milk yield in winter, 10 quarts.

Milk is all sold. At the time of report the daily feed was as follows:

	Pounds.
Corn stover	10
Corn ensilage	15
Sugar beets	10
Corn meal	5
Wheat bran	5
Ground oats	5

The amount of digestible matter in such a ration would be about as follows:

	Pounds.
Albuminoids	1.88
Carbohydrates	14.32
Fat	.68
Nutritive ratio	1 : 8.5

The above ration, like most rations, according to German standards, is deficient in albuminoids and strong in carbohydrates.

No. 2. Ithaca, N. Y.:

Twelve cows, grade Holstein three-quarters to fifteen-sixteenths, averaging 1,122 pounds, live weight, and were yielding, February eighteen, on an average, thirty pounds milk per day.

Milk is all sold for immediate consumption.

The daily feed was as follows:

	Pounds.
Clover hay	9.58
Corn ensilage	42.
Mangolds	12.2
Corn meal	2.8
Wheat bran	2.
Cotton-seed meal	3.66

The digestible matter contained would be approximately as follows:

	Pounds.
Albuminoids	2.57
Carbohydrates	10.21
Fat	1.12
Nutritive ratio	1 : 5.1

The last ration, judged by the standard, would be considered well-balanced, although the proportion of fat is in excess.

No. 3. Goshen, N. Y.:

Twenty-five cows in herd, of Dutch Belted breed. Average live weight, about 1,000 pounds; cows go dry one to two months.

In summer cows give about sixteen quarts per day, and in winter thirteen quarts.

Their feed per day in December, 1888, was as follows:

	Pounds.
Mixed hay (assumed)	10
Corn stover (assumed)	5
Corn meal	2
Wheat bran and middlings	4
Brewers' grain (assumed)	30

The amount of hay, stover and brewers' grains are not given, but from report the above amounts are assumed as approximately correct.

Assuming, as has been necessary, the amounts of food consumed as indicated, the digestible matter is shown below:

	Pounds.
Albuminoids	2.37
Carbohydrates	13.07
Fat	.66
Nutritive ratio	1 : 6.1

While the ration fed in this case is hardly up to the standard, yet, according to American experience, it is about the most economical.

No. 4. Avon, N. Y.:

Nine grade Jerseys and one Holstein, weighing 1,000 pounds each. Cows go dry one to four weeks, and come in milk all the year round.

In summer the milk yield averages about eighteen quarts, and in winter ten quarts. The milk is all sold.

	Pounds.
Meadow hay (assumed)	8
Corn stover (assumed)	10
Bean straw (assumed)	15
Beets	....
Corn meal	8
Wheat bran	8
Linseed meal	1

The amounts of hay stover and straw are not given, but from report apportioned as above.

It is hardly probable that the animals consumed all the coarse food as indicated above, as when fed straw a portion is generally uneaten. As the figures stand, the digestible matter would be:

	Pounds.
Albuminoids	2.77
Carbohydrates	17.50
Fat	.76
Nutritive ratio	1 : 6.9

The grain ration indicated is a very liberal one, and the total amount is in excess of the standards, but the proportions lean towards carbohydrates.

No. 5. Milford, N. Y.:

Hereford cows, fifteen in herd, and averaging 1,450 pounds, live weight.

	Pounds.
Meadow hay	20
Turnips (one bushel)	60
Oats ground (four quarts)	4
Corn and cob meal (four quarts)	4

A portion of the time ten pounds of hay are fed, and one feed per day of straw or corn stover.

The digestible matter contained in the above ration would be about as follows:

	Pounds.
Albuminoids	1.55
Carbohydrates	13.88
Fat	.62
Nutritive ratio	1 : 9.9

The ration is very deficient in albuminoids for milk production, but as this herd is kept for breeding rather than milk, the ration may be considered a liberal one.

No. 6. Gerry, N. Y.:

Fifteen cows in herd, Short-horns, and average about 1,300 pounds, live weight. Cows go dry about four months, and mostly come in during February.

The feed per day averages about as follows:

	Pounds.
Meadow hay	10
Corn stover (assumed)	5
Straw (assumed)	5
Turnips	15
Corn meal	2
Wheat bran	2

The turnips are pulped and mixed with the hay, straw and stover.

The ration as apportioned above would contain of digestible matter as follows:

	Pounds.
Albuminoids	.96
Carbohydrates	10.53
Fat	.31
Nutritive ratio	1 : 11.5

The ration given above must be considered as very deficient in albuminoids, and whether for milk or butter production, there can be little question but what the replacing of the corn meal by some of the highly nitrogenous products would result in improvement.

No. 7. Brockport, N. Y.:

Twelve cows in herd, Jersey breed, and cows go dry about one month.

Annual butter product per cow, 320 pounds.

The feed per day when reported, was as follows:

	Pounds.
Meadow hay	12
Corn meal	3
Wheat bran	3
Linseed meal	3
Oat meal	3

The proprietor writes that he feeds more of fodder corn than hay. The fodder corn taking the place of hay, and cows have all they will eat, the grain being the same, he sees no difference in results.

The digestible matter contained in the above ration is found to be follows:

	Pounds.
Albuminoids	2.03
Carbohydrates	10.03
Fat	.63
Nutritive ratio	1 : 5.7

This ration is very close to what American experience seems to indicate as a profitable and economical ration. The performance of the animals (320 pounds of butter per year) confirms the opinion. The ration employed is worthy of study by dairymen who wish to combine their foods in a profitable ration for milch cows.

No. 8. Leonardsville, N. Y.:

Thirty cows in herd, Holstein-Friesian and Guernsey, averaging about 1,000 pounds, live weight. Cows go dry about six weeks, and come in milk all times a year.

Average butter product per year, 470 pounds.

The daily ration was, at the time of report, as follows:

	Pounds.
Meadow hay	20
Corn ensilage	50
Corn meal	3
Wheat bran	7
Cotton-seed meal	3

Linseed meal is substituted a part of the time for the cotton-seed meal. In summer, besides cows being at pasture, fifty pounds ensilage and ten pounds mixed grain are fed, and in season green oats, rye and clover.

The amount of digestible matter in this ration is shown below:

	Pounds.
Albuminoids	3.01
Carbohydrates	17.21
Fat	1.27
Nutritive ratio	1 : 6.7

The ration fed is a heavy one, being an excess of both nitrogenous and carbonaceous matter, as judged by German standards. The annual butter product per cow for the herd may be considered phenomenal when we recall that the average in the State must be less than 130 pounds per cow. The ration, fed in a well-selected herd, warrants the results, and shows what may be accomplished by careful breeding and judicious feeding.

No. 10. Cambridge, N. Y.:

Eight cows, brown Swiss breed, averaging about 1,150 pounds, live weight. Cows go dry two or three months, and come in mostly in April and May.

Butter product average per year, 156 pounds.

	Pounds.
Meadow hay	12
Corn stover	13
Straw	8

The digestible matter in the above ration is shown by the following:

	Pounds.
Albuminoids	.85
Carbohydrates	12.61
Fat	.28
Nutritive ratio	1 : 15.6

The ration as shown above is wonderfully deficient in albuminoids, and the results for the herd strongly indicate that the addition of some nitrogenous grain food would be followed by an increased output and in economy of food.

No. 11. Holland Patent, N. Y.:

The herd consists of eleven Jerseys and grade Jerseys. Cows go dry about three weeks and come in milk at all seasons.

Average annual milk yield, about 5,000 pounds.

Average butter per cow, annually, 300 pounds.

The following was the ration fed at date of report:

	Pounds.
Meadow hay	3
Corn ensilage	40
Wheat bran	4
Cotton-seed meal	2

The above ration calculated for digestible matter is as follows:

	Pounds.
Albuminoids	1.52
Carbohydrates	6.59
Fat	.71
Nutritive ratio	1 : 5.5

According to German standards, this ration would be considered perfectly balanced as regards the relation of albuminoids to carbohydrates. The interesting feature is the small amount of dry matter consumed per day by the animals. When we consider the returns given by the cows, an average annual butter product of 300 pounds, it is evident the food is well-digested and assimilated by the animals.

FEEDING EXPERIMENTS.

The feeding experiments for the winter of 1888–9, with growing and fattening animals were made as previously planned* for the purpose of comparing the relative feeding values of a nitrogenous versus a carbonaceous ration. For our subjects we had four grade Holstein-Shorthorn animals two years old. The lot consisted of two steers and two heifers selected from a number of young animals as nearly uniform as possible. The two steers were named Broad and Whitey and the two heifers Star and Spot. Their weight when taken from the pasture, November eight, and brought to the experimental feeding barn was for each lot, as follows:

Lot I.

	Pounds.
Broad	790
Star	691
Total	1,481

Lot II.

	Pounds.
Whitey	790
Spot	750
Total	1,540

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* Bulletin No. 10, p. 39.

For some days after being transferred to the barn from pasture they continued to decrease in weight, and their average weight from November eight to November twenty, was:

Lot I.	Pounds.
Broad	776
Star	700

Lot II.	Pounds.
Whitey	761
Spot	724

When put into the barn, as judged from appearance for feeding purposes, Broad was rather better than Whitey, and Spot preferable to Star, but the apparent difference was slight, so we may consider the two lots as about equal.

For hay and other coarse fodder both lots were to be treated alike, but in addition, Lot I was to receive a grain ration made up of foods considered highly nitrogenous, while Lot II would receive a grain ration highly carbonaceous.

The ration varied considerably during the several periods, both as regards the nutritive ratio and the kind of foods entering into their composition. The foods used were as follows:

Hay, a mixture of cultivated grasses, mainly timothy and red clover.

Ensilage, from Burrell & Whitman corn put in the silo while the kernels varied from the watery to the milky stage.

Roots. Turnips were fed except in the last period of twelve days, when beets were substituted.

Corn meal was made from flint corn Station crop; wheat bran of the roller process; linseed meal, old process and gluten meal. This is a by-product from the manufacture of starch and glucose from corn. It is highly nitrogenous, containing but little ash, and is now considerably used by farmers. Cotton-seed meal of good quality and fresh was fed during a portion of the trial.

Salt was kept always before the animals so that they had free access.

Water was offered twice per day and the amount drunk recorded in pounds.

All food was weighed in to each animal and the waste weighed back each day, so that the actual amount of food consumed is known. The animals were weighed each morning before receiving food or drink and the records transcribed to the office books.

With the exception of the beets every food was carefully analyzed and digestion experiments made, so we have the necessary data for a complete record of the feed consumed and growth of the animals.

COMPOSITION OF FOOD.

	Water.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay	14.29	4.19	7.88	28.91	41.93	2.80
Ensilage, No. 1	81.08	.95	1.13	4.90	10.86	1.08
Ensilage, No. 2	78.34	1.06	1.58	6.32	11.38	1.32
Turnips	91.26	.66	.99	1.16	5.60	.33
Corn meal, No. 1	13.60	1.23	9.50	1.79	69.54	4.34
Corn meal, No. 2	20.04	1.45	10.39	1.41	62.92	3.79
Wheat bran	13.71	5.49	15.13	8.27	54.35	3.05
Gluten meal	9.58	.68	30.12	2.73	50.26	6.53
Linseed meal	12.10	5.17	30.48	7.69	35.51	9.05

The feeding trial proper continued for 163 days, or from November eleven to April twenty-third, but the period from February nineteen to March nine was somewhat modified, in order to enable us to determine the digestibility of the foods used.

On account of the digestion experiment we shall divide the trial into two general periods, the first extending to February twenty-eighth, when the digestion experiment proper began, the second from the close of the digestion experiment to the end of the feeding. These general periods are also divided, for convenience, into periods of like feeding, and periods of ten days.

Before entering into these subdivisions we may give the total amounts of food consumed by each animal, and the gain made upon that food irrespective of the nature of the products entering into each ration. The total food consumed by each animal is shown in the following table:

TOTAL FOOD CONSUMED FROM NOVEMBER 11 TO APRIL 23, 1888–89.

	Hay.	Ensilage.	Roots.	Corn meal.	Wheat bran.	Linseed meal.	Gluten meal.	Cotton-seed meal	Water drunk.	Daily gain.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Broad	1,756	1,068	434	564	708	102	120	184	7,730	1.79
Star	1,664	807	563	496	490	102	120	138	5,559	1.55
Whitey	1,628	775	461	1,299	326	......	......	......	6,370	1.72
Spot	1,624	1,442	424	1,226	298	......	......	......	6,029	1.69

Lot I.—Food From November 11 to April 23, 1888–9.

Broad.

	Water.	Dry matter.	Ash.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Hay	250.9	1505.1	73.6	138.4	507.6	736.4	49.2
Ensilage	851.3	216.7	10.7	14.4	59.9	118.8	12.8
Roots	396.0	38.0	3.6	4.3	5.0	24.3	1.4
Corn meal	94.9	469.1	7.6	56.1	9.0	373.6	22.9
Wheat bran	97.1	610.9	38.8	107.1	58.5	384.8	21.6
Linseed meal	12.3	89.7	5.3	31.1	7.8	36.2	9.2
Gluten meal	11.5	108.5	.8	36.1	3.3	60.3	7.8
Cotton-seed meal	17.0	167.0	12.0	77.2	12.0	46.0	19.8
Total	1731.0	3205.0	152.4	464.7	663.1	1780.4	144.7

Star.

	Water.	Dry matter.	Ash.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay	237.8	1426.2	70.0	131.1	481.1	697.7	46.6
Ensilage	644.9	162.1	8.1	10.9	44.9	89.8	9.7
Roots	513.8	49.2	3.7	5.6	6.5	31.5	1.8
Corn meal	83.4	412.6	6.6	49.3	7.9	328.5	20.1
Wheat bran	67.2	422.8	26.9	74.1	40.5	266.3	14.9
Linseed meal	12.3	89.7	5.3	31.1	7.8	36.2	9.2
Gluten meal	11.5	108.5	.8	36.1	3.3	60.3	7.8
Cotton-seed meal	12.7	125.3	9.0	57.8	9.0	34.5	14.8
Total	1583.6	2796.4	130.4	396.0	601.0	1544.8	124.9

Lot II.—Food from November 11 to April 23, 1888–9.

Whitey.

	Water.	Dry matter.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Hay	232.6	1395.5	68.2	128.3	470.6	682.5	45.6
Ensilage	617.7	157.3	7.7	10.5	43.5	86.2	9.3
Roots	420.7	40.3	3.0	4.5	5.3	25.8	1.5
Corn meal	218.5	1080.5	17.4	129.1	20.8	860.5	52.7
Wheat bran	44.7	281.3	17.9	49.3	26.9	177.2	9.9
	1534.2	2954.8	114.2	321.7	567.1	1832.2	119.0

Spot.

	Water.	Dry matter.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay	232.1	1391.9	68.0	127.9	469.5	680.9	45.5
Ensilage	1149.4	292.6	14.4	19.5	80.9	160.5	17.3
Roots	386.9	37.1	2.8	4.2	4.9	23.7	1.4
Corn meal	206.2	1019.8	16.4	121.9	19.6	812.1	49.8
Wheat bran	40.9	257.1	16.4	45.1	24.6	162.0	9.1
	2015.5	2998.5	118.0	318.6	599.5	1839.2	123.1

To summarize the results presented in the last table we have for each lot, as follows:

	Water drunk.	Water in food.	Dry matter.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Lot I........	13289	3314.6	6001.4	282.8	860.7	1264.1	3325.2	269.6
Lot II........	12399	3549.7	5953.3	232 2	640.3	1166.6	3671.4	242.1

The gain for the 163 days was as follows:

Lot I.	Pounds.
Broad	290
Star	251
Total	541

Lot II.	Pounds.
Whitey	279
Spot	275
Total	554

From what has already been given, we see that for the entire trial the amounts of dry matter consumed by the two lots were pretty nearly the same, with the gain in live weight in favor of Lot II. Lot I received more than 200 pounds of albuminoids during the entire period more than did Lot II, but in order to find the actual difference in feed, we must compare the rations for the several periods.

As already stated the object of the feeding trial was to determine the relative influence for growth and fattening of different rations, the one being constantly more nitrogenous than the other. For the purpose of tracing the influence of these rations, we may break up the first portion of our trial (up to the digestion experiment) into periods of ten days each. The following table gives the average daily food and water consumed, beginning with November eleventh:

	LOT I.		LOT II.	
	Broad.	Star.	Whitey.	Spot.
NOVEMBER 11-21.	Pounds.	Pounds.	Pounds.	Pounds.
Live weight	776	700	761	724
Water drunk	55.2	37.0	45.3	43.4
Hay eaten	15.3	11.7	12.4	11 6
Corn meal	4.0	4.0	6.2	6.2
Wheat bran	2.0	2.0	2.0	2.0
Linseed meal	2.2	2.2	....	....

	Lot I.		Lot II.	
	Broad.	Star.	Whitey.	Spot.
NOVEMBER 21-DECEMBER 1.	Pounds.	Pounds.	Pounds.	Pounds.
Live weight	810	716	787	748
Water drunk	61.7	45.8	52.7	50.0
Hay eaten	15.9	12.5	13.4	12.8
Corn meal	4.0	4.0	8.0	8.0
Wheat bran	2.0	2.0	2.0	2.0
Linseed meal	4.0	4.0	....	....
DECEMBER 1-11.				
Live weight	826	731	796	772
Water drunk	49.3	32.6	42.8	40.7
Hay eaten	11.9	10.2	10.6	10.2
Ensilage	11.3	6.9	7.2	11.9
Corn meal	4.0	4.0	8.0	8 0
Wheat bran	2.0	2.0	2.0	2.0
Linseed meal	4.0	4.0	....	....
DECEMBER 11-21.				
Live weight	845	752	800	788
Water drunk	39.7	32.4	35.2	32.0
Hay eaten	11.3	9.2	9.4	8.9
Ensilage	13.5	7.7	8.0	14.8
Corn meal	4.0	4.0	10.0	10.0
Wheat bran	2.0	2.0	2.0	2.0
Gluten meal	4.0	4.0	....	....
DECEMBER 21-31.				
Live weight	862	767	823	818
Water drunk	39.8	26.1	31.7	31.4
Hay eaten	10.8	9.0	8.4	8.4
Ensilage	10.4	7.4	6.9	16.9
Corn meal	4.0	4.0	10.0	10.0
Wheat bran	2.0	2.0	2.0	2.0
Gluten meal	4.0	4.0	....	....
DECEMBER 31—JANUARY 9.				
Live weight	876	785	825	827
Water drunk	41.9	36.1	33.7	33.6
Hay eaten	8.3	7.5	8.1	6.7
Ensilage	12.7	8.5	5.3	17.3
Corn meal	4.0	4.0	4.5	10.0
Wheat bran	2.0	2.0	2.0	2.0
Gluten meal	4.0	4.0	....	....
JANUARY 10-20.				
Live weight	891	812	838	852
Water drunk	41.8	25.2	31.6	33.6
Hay eaten	8.1	9.0	7.9	6.7
Ensilage	12.1	8.3	8.9	19.4
Corn meal	4.0	3.2	9.8	10.0
Wheat bran	7.4	4.5	2.0	2.0
JANUARY 20-30.				
Live weight	922	820	853	875
Water drunk	43.9	38.9	34.2	37.8
Hay eaten	8.0	9.7	6.8	7.2
Ensilage	13.0	8.4	7.1	18.9
Corn meal	4.0	4.0	10.0	10.0
Wheat bran	8.0	5.4	2.0	2.0
JANUARY 30—FEBRUARY 9.				
Live weight	940	842	879	886
Water drunk	43.2	29.0	35.0	33.5
Hay eaten	9.2	9.7	8.5	8.8
Roots	9.7	10.1	10.8	7.7
Corn meal	4.0	4.0	10.0	10.0
Wheat bran	8.0	6.2	2.0	2.0
FEBRUARY 9-19.				
Live weight	964	855	909	904
Water drunk	45.8	26.0	33.0	32.9
Hay eaten	9.2	8.9	9.0	9.6
Roots	11.2	10.7	11.9	10.8
Corn meal	4.0	3.9	10.0	10.0
Wheat bran	9.6	6.5	2.0	2.0
FEBRUARY 19-28.				
Live weight	972	864	939	926
Water drunk	54.6	27.0	38.0	34.0
Hay eaten	9.1	12.3	9.1	12.5
Roots	5.2	11.2	6.7	6.7
Corn meal	4.0	1.9	10.0	5.6
Wheat bran	7.0	1.4	2.0	1.1
Cotton-seed meal	2.4	0.7	....	....

At this time the rations were considerably changed in order to have a digestion experiment, hence we may consider the data up to this date by itself. During the first period after the animals were taken from pasture and put in the barn, there was a rapid falling off in weight, probably, however, not so much a loss in flesh as of water and diminished feed.

We may first present the apparent gain per day for each period, that is, the gain between the average daily weighings for each full period, as follows:

AVERAGE DAILY GAIN.

	LOT I.		LOT II.	
	Broad.	Star.	Whitey.	Spot.
	Pounds.	Pounds.	Pounds.	Pounds
November 11-21	....	....	....	....
November 21-December 1	3.4	1.6	2.6	2.4
December 1-11	1.6	1.5	.9	2.4
December 11-21	1.9	2.1	.4	1.6
December 21-31	1.7	1.5	2.3	3.0
December 31-January 10	1.4	1.8	.2	.9
January 10-20	1.5	2.7	1.3	2.5
January 20-30	3.1	.8	1.5	2.3
January 30-February 9	1.8	2.2	2.6	1.1
February 9-19	2.4	1.3	3.0	1.8
February 19-28	0.9	1.0	3.3	2.4
Average daily gain	1.9	1.6	1.5	1.8

In the 109 days included in the trial, the apparent total gain for each lot was as follows:

	Pounds gain.
Lot I	360
Lot II	380

With the animals under experimentation, in this case the ration fed Lot II gave better gain by nearly two-tenths of a pound per day, that is the carbonaceous ration gave rather better returns in live-weight than did the nitrogenous one.

Since the gain for the two lots was found to be in favor of the carbonaceous feed, we may look to see the actual amounts of the several foods consumed during the 109 days and the chemical composition of the same. In tabular form we present the weights of food consumed by each animal from November eleventh to February twenty-eighth.

	LOT I.		LOT II.	
	Broad.	Star.	Whitey.	Spot.
	Pounds.	Pounds.	Pounds.	Pounds.
Water drunk	5115.9	3538.5	4098.8	3996.8
Hay	1164.5	1086.8	1029.0	1024.7
Roots	256.0	309.1	288.4	244.5
Ensilage	730.4	472.0	435.3	560.0
Corn meal	436.0	407.6	934.8	952.0
Wheat bran	513.1	378.4	218.0	210.1
Linseed meal	102.0	102.0	....	....
Gluten meal	120.0	120.0	....	....
Cotton-seed meal	21.9	6.2	....	....

To show the total amount of the food constituents consumed during the 109 days feeding, we present the following table:

Broad.

	Water.	Dry matter.	Ash.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay	166.4	998.1	48.8	91.8	336.7	488.3	32.6
Ensilage	582.3	148.1	7.3	9.9	41.0	81.3	8.8
Roots	233.6	22.4	1.7	2.6	3.0	14.3	.8
Corn meal	73.3	352.7	5.8	43.3	7.0	288.8	17.7
Wheat bran	70.3	442.7	28.1	77.6	42.4	278.9	15.6
Linseed meal	12.3	89.7	5.3	31.1	7.8	36.2	9.2
Gluten meal	11.5	108.5	.8	36.1	3.3	60.3	7.8
Cotton-seed meal	2.0	19.9	1.4	9.2	1.4	5.5	2.3
Total	1151.7	2182.1	99.2	301.6	442.6	1253.6	94.8

Star.

Hay	155.3	931.5	45.5	85.6	314.2	455.7	30.4
Ensilage	376.2	95.8	4.7	6.3	26.5	52.5	5.7
Roots	282.1	27.0	2.0	3.0	3.6	17.3	1.0
Corn meal	68.6	339.0	5.5	40.5	6.5	270.0	16.5
Wheat bran	51.9	316.5	20.8	57.2	31.3	205.6	11.4
Linseed meal	12.3	89.7	5.3	31.1	7.8	36.2	9.2
Gluten meal	11.5	108.5	.8	36.1	3.3	60.3	7.8
Cotton-seed meal	.6	5.6	.4	2.6	.4	1.5	.7
Total	958.5	1913.6	85.0	262.4	393.6	1099.1	82.7

Whitey.

	Water.	Dry matter.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay	147.0	882.0	43.1	81.1	297.5	431.5	28.8
Ensilage	346.9	88.4	4.4	5.9	24.4	48.4	5.2
Roots	263.2	25.2	1.9	2.9	3.3	16.1	.9
Corn meal	157.2	777.6	12.5	92.9	14.9	619.2	37.9
Wheat bran	29.9	188.1	11.9	32.9	18.0	118.5	6.6
Total	944.2	1951.3	73.8	215 7	348.1	1233.7	79.4
Spot.							
Hay	146.4	878.3	42.9	80.7	296.2	429.6	28.7
Ensilage	446.4	113.6	5.6	7.6	31.4	62.3	6.7
Roots	223.1	21.4	1.6	2.4	2.8	13.7	.8
Corn meal	160.1	792.1	12.8	94.6	15.2	630.6	38.6
Wheat bran	28.8	181.2	11.5	31.8	17.4	114.2	6.4
Total	1004.8	1986.6	74.4	217.1	363.0	1250.4	81.2

The total amount of several food constituents and water consumed by each lot is shown below, expressed in pounds:

	Lot I.	Lot II.
Water	10764.6	10044.6
Dry matter	4095.7	3937.9
Ash	184.2	148.2
Albuminoids	564.0	432.8
Crude fiber	836.2	711.1
Nitrogen-free extract	2352.7	2484.1
Fat	177.5	160.6

Lot I received rather more dry matter than Lot II, and made slightly better gain. Lot I received 131 pounds, or 1.2 pounds per day more albuminoids than did Lot II. On the other hand Lot II consumed just 131 pounds more nitrogen-free extract than did Lot I. It is plain then that in this particular trial we can trace no apparent increased value for the substitution of albuminoids for nitrogen-free extract. We must then look for any differences in the amount digested, and for this purpose the digestion experiments were carried out with these same animals. Before considering these trials we give, calculated from the food consumed and the average digestion coefficients, the amounts of digestible matter contained in the food of each lot of animals as follows:

Digestible matter consumed for the entire period.

	Lot I.	Lot II.
Albuminoids	392.6	282.0
Crude fiber	399.1	337.8
Nitrogen-free extract	1719.0	1928.3
Fat	127.8	115.5

Using the average digestion coefficients for the feeds consumed we find that Lot I received 110 pounds digestible albuminoids more than Lot II, but 209 pounds more of digestible nitrogen-free extract was fed to Lot II than to Lot I.

In order to test the digestibility of the rations at this point, it was necessary to modify somewhat the feeding, and from February twenty-eighth to March tenth Broad and Whitey received the regular rations minus roots. Star was fed hay and roots only, and Spot hay alone. During this period they all continued to make a fair gain, but in the ten days following they showed the effect of the previous feeding, and both Star and Spot lost weight. It is worthy of note that the real influence of the food did not manifest itself until the following period.

The feeding trial continued until April twenty-third, or for fifty-four days longer. Dividing this into five periods, the first three of ten and the last two of twelve days each, and we have the following summary per day for each period:

	LOT I.		LOT II.	
	Broad.	Star.	Whitey.	Spot.
FEBRUARY 28-MARCH 10.	Pounds.	Pounds.	Pounds.	Pounds.
Live weight	983	882	949	939
Water drunk	55.9	30.4	39.0	40.3
Hay eaten	8.8	13.6	8.7	16.3
Roots	....	7.7	....	....
Corn meal	4.0	....	10.0	....
Wheat bran	7.0	....	2.0	....
Cotton-seed meal	3.0	....	....	....
MARCH 10-20.				
Live weight	1010	877	965	937
Water drunk	50.8	37.8	38.9	37.4
Hay eaten	10.2	9.1	10.2	8.9
Ensilage	11.2	11.6	10.8	14.8
Corn meal	2.0	2.0	6.0	6.0
Wheat bran	3.0	3.0	2.0	2.0
Cotton-seed meal	3.0	3.0	....	....

	LOT I.		LOT II.	
	Broad.	Star.	Whitey.	Spot.
MARCH 20-30.	Pounds.	Pounds.	Pounds.	Pounds.
Live weight	1032	899	997	963
Water drunk	44.9	37.9	34.2	34.4
Hay eaten	10.6	9.7	10.7	9.5
Ensilage	11.7	12.4	12.0	14.7
Corn meal	2.0	2.0	6.0	6.0
Wheat bran	3.0	3.0	2.0	2.0
Cotton-seed meal	3.0	3.0	....	....
MARCH 30 - APRIL 11.				
Live weight	1050	923	1022	977
Water drunk	44.1	39.9	49.1	37.9
Hay eaten	12.0	10.1	12.5	10.4
Ensilage	9.0	9.6	9.4	13.0
Corn meal	2.0	2.0	6.0	6,0
Wheat bran	3.0	3.0	2.0	2.0
Cotton-seed meal	3.0	3.0	....	....
APRIL 11-23.				
Live weight	1066	951	1040	999
Water drunk	45.1	40.1	46.7	48.6
Hay eaten	12.7	10.9	12.9	10.8
Roots	14.9	14.7	14.5	15.0
Corn meal	2.0	2.0	6.0	6.0
Wheat bran	3.0	3.0	2.0	2.0
Cotton-seed meal	3.0	3.0	....	....

The average daily gain for the five divisions of fifty-four days is shown by the following:

	LOT I.		LOT II.	
	Broad.	Star.	Whitey.	Spot.
	Pounds.	Pounds.	Pounds.	Pounds.
February 28-March 10	1.1	1.8	1.0	1.3
March 10-20	2.7	-.5	1.6	-.2
March 20-30	2.2	2.2	3.2	2.6
March 30-April 11	1.5	2.0	2.1	1.1
April 11-23	1.3	2.3	1.5	1.8

In the fifty-four days included in this trial there was a gain for each lot as follows:

	Pounds gain.
Lot I	181
Lot II	174

This time the gain was in favor of Lot I, or the nitrogenous fed animals.

The total food consumed to produce the gain as indicated in the fifty-four days was as follows:

	LOT I.		LOT II.	
	Broad.	Star.	Whitey.	Spot.
	Pounds.	Pounds.	Pounds.	Pounds.
Water drunk	2587	2021	2271	2033
Hay eaten	592.6	577.9	599.7	600.3
Ensilage	338.1	335.9	340.5	451.0
Roots	178.5	254.5	173.2	180.0
Corn meal	128.0	88.0	364.0	264.0
Wheat bran	202.0	132.0	108.0	88.0
Cotton-seed meal	162.0	132.0	....	....

The amount of the several components entering into each food and consumed per day by each animal is shown by the following:

Broad.

	Water.	Dry matter.	Ash.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay	84.5	507.0	24.8	46·6	170.9	248.1	16.6
Ensilage	269.0	68.6	3.4	4.5	18.9	37.5	4.0
Roots	162.4	15.6	1.0	1.7	2.0	10.0	0.6
Corn meal	21.6	116.4	1.8	12.8	2.0	84.8	5.2
Wheat bran	26.8	168.2	10.7	29.5	16.1	105.7	6.0
Cotton-meal seed	15.0	147.1	10.6	68.0	10.6	40.5	17.5
			Star.				
Hay	82.5	494.7	24.5	45.5	166.9	242.0	16.2
Ensilage	268.7	66.3	3.5	4.6	18.4	37.3	4.0
Roots	231.7	22.2	1.7	2.6	2.9	14.2	0.8
Corn meal	14.8	73,6	1.1	8.8	1.4	58.5	3.6
Wheat bran	15.3	106.3	6.1	16.9	9.2	60.7	3.5
Cotton-seed meal	12.1	119.7	8.6	55.2	8.6	33.0	14.1
			Whitey.				
Hay	85.6	513.4	25.1	47.2	173.1	251.0	16.8
Ensilage	270.8	68.9	3.3	4.6	19.1	37.8	4.1
Roots	157.5	15.1	1.1	1.6	2.0	9.7	.6
Corn meal	61.3	302.9	4.9	36.2	5.9	241.3	14.8
Wheat bran	14.8	93.2	6.0	16.4	8.9	58.7	3.3
			Spot.				
Hay	85.7	513.6	25.1	47.2	173.3	251.3	16.8
Ensilage	703.0	179.0	8.8	11.9	49.5	98.2	10.6
Roots	163.8	15.7	1.2	1.8	2.1	10.0	.6
Corn meal	46.1	227.7	3.6	27.3	4.4	181.5	11.2
Wheat bran	12.1	75.9	4.9	13.3	7.2	47.8	2.7

The total amount consumed during the entire period of fifty-four days by each lot was as follows:

	Lot I.	Lot II.
Water	1204.4	1600.7
Dry matter	1905.7	2005.3
Ash	97.7	84.0
Albuminoids	296.7	207.5
Crude fiber	427.9	445.5
Nitrogen-free extract	972.1	1187.3
Fat	92.1	81.5

In this period Lot I consumed eighty-nine pounds more of albuminoids than Lot II but Lot II received 215 more of nitrogen-free extract than Lot I, and made the less gain.

Calculating the amount of the several parts digested for each lot and we have the following:

	Lot I.	Lot II.
Albuminoids	219.05	132.91
Crude fiber	200.63	222.61
Nitrogen-free extract	658.48	845.26
Fat	71.18	66.17

Here, as in the total amounts consumed, the relation for the albuminoids and crude fiber fed to each lot holds about the same.

For the entire period of 163 days feeding, the difference in the amount of dry matter consumed was very nearly the same for each lot, but of digestible albuminoids and nitrogen-free extract there was a marked difference.

Lot I received 197 pounds more of digestible albuminoids than Lot II and this would be equivalent to .6 of a pound per day more to each animal than for Lot II. On the other hand Lot II consumed 396 pounds more of digestible nitrogen-free extract than Lot I. This would be about 1.2 pound per day more nitrogen-free extract consume by each animal in Lot I than by those of Lot II. The amount of fat consumed per day was in favor of Lot I.

The total gain for each lot was nearly the same, the small difference of thirteen pounds being in favor of Lot II, but this is a difference of about .03 of a pound per day for each animal. The gain per day for the animals in Lot I averaged 1.66 pounds and for those of Lot II 1.69 pounds per day for the entire period.

Gain in live weight for 163 *days.*

	Pounds.
Lot I	541
Lot II	554

We must then conclude that so far as this experiment goes to show the substitution of nitrogenous foods — like cotton-seed meal, etc., for corn meal and a small quantity of bran was not followed by any advantage as a fattening ration so far as the increase in live weight indicates.

In general appearance Lot I looked much the best, having a cleaner, brighter coat of hair, and this difference is shown in the case of the two steers by the photographs taken at the close of the experiment.

The photographs of the meat shows little, if any, difference in the proportion of fat and lean.

The butcher to whom the cattle were disposed of furnished us a sample of steak from each, also a roast. They were both cooked at the same time and under the same conditions. No one could mistake the difference. The meat from Whitey, carbonaceous fed animal, was much the tenderer and sweetest. Some allowance must, however, be made for Whitey was slaughtered first and the meat consequently was better "ripened." In our estimation this difference would not account for so wide a variation as was found in the samples of meat, neither can we say the difference was due wholly to feed, since we can not determine the difference in individuality.

DIGESTION EXPERIMENTS.

During the winter of 1888–89 six digestion experiments were planned and carried out. These experiments are the united work of Mr. Emery, Mr. Wheeler and myself. The digestion experiments were conducted with the animals used in the feeding trials and the foods tested, the same as constituted the rations of the animals during several periods of the feeding. The object was to make the trials with such rations as are generally fed by farmers. Already more than thirty feeding trials have been made in America to determine the digestibility of single foods but of rations little seems to be known as to their digestibility. The feeding trials were made to determine the digestibility of certain rations and to make a beginning for studying the influence upon the digestibility of different foods compounded into a ration.

A few trials like these can answer no mooted question, but by beginning the work and carefully recording the data we have perhaps the foundation laid for future work, and may gather suggestions as to certain lines best to be followed out in order to arrive at practical results.

EXPERIMENT I.

Object.— As lucerne or alfalfa is now receiving considerable attention it was thought advisable to have a feeding trial to learn something of the value and digestibility of alfalfa hay.

Animal.— A Jersey cow, Flora, 4 years old, two months in milk.

Food.— Alfalfa hay in sufficient quantity.

EXPERIMENT II.

Object.— The hay fed by the majority of farmers is a mixture of grasses and clover and such a hay was selected (consisting mainly of timothy and clover), in order to find what proportion of it was digested and to serve as the basis for calculation in our winter's feeding trial.

Animal.— Grade Holstein heifer, Spot, 2 years old, used in the feeding experiment, Lot I.

Food.— Hay as already described in sufficient quantity.

EXPERIMENT III.

Object.— Roots are fed to quite an extent and this experiment was planned to see whether in a ration of hay and roots there would be any manifest influence of the roots on the digestibility of the hay.

Investigators have claimed that roots tend to decrease the digestibility of the albuminoids of the coarse fodders. The experiment was planned specially to test the correctness of this claim.

Animal.— Grade Holstein heifer, Star, 2 years old, used in the feeding experiment, Lot II.

Food.— Hay from the same lot as in Experiment II, and turnips in moderate quantity at noon.

EXPERIMENT IV.

Object.— In our feeding trials for the winter two series of rations were fed, one made up of nitrogeneous foods and the other of more carbonaceous foods. To determine the digestibility of the nitrogeneous ration was the object of this trial.

Animal.— Grade Holstein steer, Broad, 2 years old, used in the feeding experiment, Lot I.

Food.— Hay as in two and three, wheat bran, cotton-seed meal and corn meal.

EXPERIMENT V.

Object.— In this experiment the object was to determine the digestibility of the carbonaceous ration mentioned in Experiment IV.

Animal.— Grade Holstein steer, Whitey, 2 years old, used in feeding experiment, Lot II.

Food.— Hay as in last experiment, corn meal and wheat bran.

EXPERIMENT VI.

Object.— At the present time dairymen are feeding rations in which several grain foods are used. The object in this experiment was to feed such a ration as nearly balanced as could be approximately estimated before knowing the digestibility of the several foods, and then to determine the digestibility by actual trial.

Animal.— Jersey cow Nellie, 6 years old, three months in milk.

Food.— Hay as in previous trials, oats, cotton-seed meal, linseed meal, wheat bran and corn meal.

A careful examination of the hay fed in the trial was made by Mr. Emery, and as the hay was about an average, as meadow hays generally run, the results secured are of interest in showing the proportion of the various grasses, clovers, weeds, etc.

A mechanical analysis of a two-pound sample showed it to be made up a follows:

	Weight in grams.	Per cent of total.
Timothy	561.0	61.44
Clover (T. hybridum)	176.0	19.28
Various grasses (chiefly poas)	44.0	4.82
White weed (L. vulgare)	83.0	9.09
Old Fog, wheat stubble and sticks	11.2	1.23
Golden rod	14.5	1.59
Plantain (P. major)	7 5	.82
May weed (anthemis cotula)	4.0	.44
Chaff (chiefly clover and white weed)	11.8	1.29
	913.0	100.00

This was a bright-looking hay of good quality. It grew on a wheat stubble seeded the year before, and was cut and housed in good condition. According to this analysis one ton of 2,000 pounds would contain of grasses, 1325.2 pounds; weeds, 238.8 pounds; clover, 385.6 pounds; chaff and old stubble, 50.4 pounds.

Several days of preliminary feeding were had in order that the animals might come under the influence of the ration. The feed in the preliminary was the same as during the days of the actual digestion experiment.

The method employed throughout was the same* as in previous trials, except the dung was collected for five instead of four days. The samples of dung from each animal for the entire period were mixed and analysis made of this rather than separate analyses for each day. The determination of water in the dung was made each day.

The average daily temperature of the barn was as follows:

	Average temperature of barn.
March 1	43
March 2	41
March 3	?
March 4	47
March 5	48
March 6	49
March 7	48
March 8	48
March 9	46

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*Seventh Annual Report New York Agricultural Experiment Station, 1888, page 270; also, Society for Promotion of Agricultural Science, 1888, page 96.

The following table gives the average amount of food consumed and water drank per day by each animal:

FOOD EATEN.	Flora.	Spot.	Star.	Broad.	Whitey.	Nellie.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Alfalfa	24.31	......	......	......	......	......
Mixed hay	......	15.87	13.17	8.79	8.83	21.5
Turnips	......	......	8.66	......	......	......
Wheat bran	......	......	......	7.00	2.00	3.25
Corn meal	......	......	......	4.00	10.00	2.2
Cotton-seed meal	......	......	......	3.00	......	2.2
Linseed meal	......	......	......	......	......	1.1
Oats	......	......	......	......	......	3.25
Water drunk	64.6	41.5	32.2	57.4	38.1	96.1

The chemical composition of these several foods is shown by the following table:

FOOD.	Water.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Alfalfa hay	15.02	6.69	13.81	27.28	34.97	2.26
Mixed hay	14.29	4.19	7.88	28.91	41.93	2.80
Turnips	91.26	.66	.99	1.16	5.60	.33
Wheat bran	13.71	5.49	15.13	8.27	54.35	3.05
Corn meal	20.04	1.45	10.39	1.41	62 92	3.79
Cotton-seed meal	9.23	6.52	41.93	6.55	25.03	10.74
Linseed meal	12.10	5.17	30.48	7.69	35.51	9.05
Oats	15.39	2.52	11.10	7.18	60.70	3.11

In the following table are given the total nitrogen, albuminoid nitrogen and amide nitrogen for each food, for the dry substance, as follows:

	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.
Alfalfa hay	2.60	1.93	.67
Mixed hay	1.47	1.22	.25
Turnip	1.82	.99	.83
Wheat bran	2.99	2.69	.30
Corn meal (2610)	1.88	1.80	.08
Cotton-seed meal	7.39	6.64	.75
Linseed meal	5.55	5.55	.....
Oats	2.10	1.85	.25

The per cent of sugars and starch for each food is given in the following table for the dry substance:

	Glucose.	Sucrose.	Starch.	Per cent of nitrogen-free extract, as sugars and starch.
Alfalfa hay	3.00	1.40	12.73	41.68
Mixed hay	8.00	2.44	15.54	63.49
Turnips	25.46	4.88	21.01	81.78
Wheat bran	1.96	2.20	46.74	82.11
Corn meal	......	2.40	69.92	89.86
Cotton-seed meal	0	9.22	8.43	48.84
Linseed meal	.20	2.32	17.48	49.52
Oats	1.20	0	49.86	71.18

The amount of dung voided per day, expressed in ounces, was as follows for each animal:

	Flora.	Spot.	Star.	Broad.	Whitey.	Nellie.
March 4-5	765.0	574.0	407.5	545.25	435.75	959.5
March 5-6	686.0	590.0	617.5	476.5	293.75	1014.0
March 6-7	814.75	588.5	578.0	614.0	503.0	934.5
March 7-8	794.5	600.0	629.0	622.5	555.0	1128.0
March 8-9	901.25	616.5	761.0	614.0	415.5	974.0
Average ounces	792.3	593.8	598.6	574.4	440.6	1002.0
Average pounds	49.5	37.1	37.4	35.9	27.5	62.6

The urine in the case of a few of the animals was collected, with results as follows:

	Flora.	Spot.	Star.	Broad.	Nellie.
	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
March 4-5	324.3	144.5	102.75	254.0	349.5
March 5-6	365.5	150.5	98.25	242.0	317.5
March 6-7	285.0	123.25	102.25	287.25	271.0
March 7-8	345.0	151.5	119.25	324.50	271.0
March 8-9	361.5	141.0	125.75	328.75	323.0
Average	336.2	142.15	109.65	287.3	327.4

The per cent of water found in the dung is shown below:

	Flora.	Spot.	Star.	Broad.	Whitey.	Nellie.
March 4-5	83.58	83.81	84.68	82.61	83.38	83.56
March 5-6	83.02	83.00	84.70	82.91	84.00	82.77
March 6-7	83.59	81.46	85.30	84.14	84.86	82.59
March 7-8	82.99	82.94	85.40	83.34	84.55	82.30
March 8-9	83.84	82.86	85.07	83.36	84.66	82.58
Average	83.40	82.81	85.03	83.27	84.27	82.76

In the following table is given the average amount per day of dry matter in the dung:

	Ounces.	Pounds.
Flora	130.93	8.18
Spot	102.07	6.37
Star	89.47	5.59
Broad	95.92	5.99
Whitey	68.99	4.31
Nellie	173.43	10.84

The dry matter of the dung was found to analyze as follows for each animal:

DUNG OF	Ash.	Albuminoids Nx 6.29.	Crude fiber.	Nitrogen-free extract.	Fat.
Flora	9.87	12.40	45.71	28.46	3.56
Spot	8.17	11.15	37.46	39.63	3.59
Star	10.06	11.44	36.33	38.43	3.74
Broad	11.07	15.19	30.57	38.28	4.89
Whitey	8.28	15.81	30.72	40.45	4.74
Nellie	8.46	12.68	34.42	41.12	3.31

The per cent of sugars and starch found in the dry matter of the dungs was as given below:

	Glucose.	Sucrose.	Starch.
Flora	0	0	13.80
Spot	0	0	15.08
Star	0	1.20	14.82
Broad	0	0	15.52
Whitey	0	0	16.00
Nellie	0	0	17.48

The total nitrogen, also per cent of albuminoid and amide nitrogen, as found in the dung, were as follows:

	Total nitrogen.	Albuminoid nitrogen.	Amide nitrogen.
Flora	1.98	1.54	.44
Spot	1.78	1.59	.19
Star	1.83	1.59	.24
Broad	2.43	2.38	.05
Whitey	2.53	2.13	.40
Nellie	2.03	1.83	.20

From data already presented we calculate the digestibility of the rations for each experiment.

EXPERIMENT I.

This experiment was carried out by myself and colleague, Mr. Emery. The outdoor work was personally attended to by Mr. Emery, and together the results were written up as a part of Bulletin No. 16—New Series. It seems necessary in the discussion of results of the series of digestion experiments to give the main features of the Bulletin at this place.

LUCERNE OR ALFALFA.

During the past two years considerable has been written concerning the value of alfalfa as a forage plant and for hay. As experiments in a limited way have been made at this Station since 1882, it seems proper to bring together such data as have accumulated during our recent feeding trials and digestion experiments with alfalfa hay.

Alfalfa or lucerne is botanically the same plant — *Medicago sativa*, Lin.— and one of the clover or leguminous family.

Alfalfa has been grown in Greece for nearly 3,000 years as a forage plant. The Romans esteemed it very highly and Columella writes that it yielded four to six crops a year.

In France the plant is known as lucerne and in Spain as alfalfa. It is grown quite extensively in southern Europe. From Spain alfalfa was introduced into South America and thence by way of Mexico to California where it still retains the Spanish name, alfalfa. While in California and many of the western and southern States it is grown quite extensively, it has never been much cultivated in the northern States. In the eastern States it was introduced from Europe and is generally known as lucerne.

The alfalfa from California is said to withstand drought far better than the lucerne of Europe, while the lucerne withstands cold winters better than the alfalfa.

With this reference to the history of the plant, we may briefly review what some of the authorities say concerning its value.

Professor Shelton: "Lucerne endures close cropping and all kinds of stock are fond of it."

C. L. Reed, of California: "When cut in bloom it makes hay of good quality for all kinds of stock, but especially for cows."

Professor George H. Cook, of New Jersey:* Of all crops hitherto grown in this State, lucerne, sometimes known as alfalfa, is one of the earliest to mature, and consequently promises most in this respect; it offers, in addition, advantages which few other plants possess; briefly, some of these are as follows:

"Lucerne when once well rooted withstands drought and frost in a remarkable manner.

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* Report Ag. Experiment Station, 1886, p. 168.

"In New Jersey it can be cut three or four times each season, for five or six years in succession, yielding under favorable conditions, as heavy tonnage per acre as fodder corn, which it notably surpasses in quality."

Dr. E. L. Sturtevant:* "Although a plant of warm climate, yet under favorable circumstances of soil it seems to do well even as far north as this State; but it requires a deep, loose sandy soil, and to be kept free from weeds.

"When cut early, before the stalks become woody, it affords a nutritious hay, well spoken of by all writers on agriculture, for the feeding of milch cows and horses."

Professor C. S. Plumb:† "No changes of weather or temperature seem to have affected this plant thus far as grown here. Station experience warrants us in believing as desirable the trial of this crop on the farm for green food.

"Although the seed is expensive, and large growth not certain after sowing, the seven years' experience here indicates that alfalfa will thrive and do well in this climate, and where good seedings are secured will yield a large, valuable crop, especially during dry weather."

It seems to be the prevalent opinion that lucerne does not flourish well so far north as New York State, but seven years experience with it at this Station proves that it can and will thrive well in this latitude. Chancellor Livingstone experimented with it with good results on his estate in Columbia county nearly ninety years ago. It has been generally conceded that, in order to succeed, lucerne must have a deep, sandy, or light loam soil. The experience of the Station has been upon heavy clay loam, some of it of a cold retentive nature. Our experience indicates that alfalfa will thrive well upon other than sandy or light loamy soils Two acres and a half of lucerne now growing at the Station, on three parts of the farm, show well the capabilities of the plant to withstand the drought and northern winters. In 1882 two plats were put down to lucerne and alfalfa. These plats have yielded several crops each season since. In 1888 they were cut three times,

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* First Annual Report, N. Y. Expt. Station, p. 78.

† Fifth Annual Report, N. Y. Ag. Experimental Station, p. 135.

ALFALFA, FORAGE PER ACRE IN 1888.

	No. 1.	No. 2.
	Pounds.	Pounds.
June 16	19,384	18,513
July 18	6,751	5,227
Sept. 24	5,009	5,009
Total	31,144	28,749

yielding an average of about fifteen tons per acre of green fodder, after having been down to grass from the original seeding six years.

From the analysis of alfalfa for different years as grown at the Station, at the period of full bloom it was found to contain 67.46

	Per cent.
Water	67.46
Ash	2.65
Albuminoids	5.91
Crude fiber	10.51
Nitrogen-free extract	12.02
Fat	1.15
Total	100.00

per cent of water. With these figures as the basis, it is found that if the fifteen tons of green fodder, having a composition like the above, were converted into hay they would be equal to 5.6 tons of hay per acre

The chemical composition of this hay is shown by the following analysis. The average of ten analyses of wheat bran, also analyses of red clover hay are given for comparison:

	Alfalfa (in bloom).	Red clover.	Wheat bran.
Water	15.02	15.35	13.71
Ash	6.69	5.50	5.53
Albuminoids	13.81	12.05	14.56
Crude fiber	27.28	25.99	10.83
Nitrogen-free extract	34.97	37.63	52.26
Fat	2.26	3.48	3.11
Total	100.00	100.00	100.00

The above analysis shows alfalfa to be much like red clover hay, and to contain nearly as much albuminoids as does wheat bran. The sugars and starch were determined with results as follows:

	Per cent.
Glucose	3.00
Sucrose	1.40
Starch	12.73

From the data presented, the total yield per acre of the several constituents in the 11,200 pounds may be calculated as follows:

	Pounds per acre.
Ash	749.2
Albuminoids	1546.7
Crude fiber	2955.4
Nitrogen-free extract	3916.6
Fat	253.1

The sugars and starch, included in the nitrogen-free extract were equal to about one-half of the total extractive matter showing a large proportion of these ingredients at the period of bloom.

	Pounds per acre.
Glucose	336.0
Sucrose	156.8
Starch	1425.7

The total amount of fertilizing matter removed from one acre by the crop for the year was very large, especially is this true of the nitrogen, potash and lime. Alfalfa is preëminently a lime-loving plant, and it is generally recommended to apply a good dressing of lime to the soil before putting down to alfalfa.

FERTILIZING MATTER IN ALFALFA.

	Pounds per acre.
Phosphoric acid	52.1
Potash	155.7
Soda	9.5
Lime	305.8
Magnesia	17.9
Nitrogen	252.0

DIGESTIBILITY.

In a feeding trial made at the Station during the past winter the digestibility of alfalfa hay was determined. The subject for experimentation was a four-year-old Jersey cow, in milk about two months when the trial was made. February twenty-third the feeding of alfalfa hay was begun, twenty-five pounds per day were offered and during the five days on which the dung was saved, an average of 24.31 pounds or 389 ounces per day were eaten. The amount of dry matter consumed per day was 322.7 ounces. From noon of March fourth until noon of March ninth, five days, men were constantly with the animals and all excreta was received in pails and at once transferred to large vessels, kept closed to prevent loss by evaporation. At the end of each twenty-four hours the dung was carefully mixed, sampled, and taken to the laboratory for analysis.

All food was weighed and the unconsumed hay for the day weighed back and sampled. This waste was kept in a large glass jar and at the end of the period analyzed, but as the details are uninteresting and unessential to discussion of results only a summary of all is given in the following table:

DATE.	Average temperature in barn.	Live weight.	Water drunk.	Hay eaten.	Milk yield.
		Lbs.	Lbs.	Lbs.	Lbs.
March 1	43	983	68.62	24.68	15.43
March 2	41	970	82.75	24.68	14.93
March 3	?	977	102.62	24.50	15.06
March 4	47	991	17.5?	24.62	15.50
March 5	48	960	94.81	24.50	15.37
March 6	49	979	53.31	24.50	14.12
March 7	48	954	69.06	24.06	14.68
March 8	48	947	88.68	23.87	14.43
March 9	46	960	75.93	24.25	14.50
Average	46	969	72.58	24.40	14.89

The amount of dung and urine per day was as follows:

	Dung.	Urine.
	Ounces.	Ounces.
March 4–5	756.0	324.2
March 5–6	686.0	365.5
March 6–7	814.7	285.0
March 7–8	794.5	345.0
March 8–9	901.3	361.5
Average	792.3	336.2

The average chemical composition of the dung, having already been given, we may present in tabular form the results as showing the digestibility of alfalfa hay as follows:

DIGESTIBILITY OF ALFALFA.

PER DAY.	Dry matter.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay eaten	322.72	52.41	105.61	135.56	9.04
Solid excrement	130.93	16.23	59.85	38.26	4.66
Amount digested	191.79	36.18	45.76	97.30	4.38
Per cent digested	59.43	68.84	43.32	71.85	48.45

The nutritive ratio of the ration proved to be 1:4.3 or considerably closer than called for by German standards.

By comparisons of the above results with those for the digestibility of clover* hay as found by Armsby, we find that alfalfa is considerably more digestible than red clover, especially is this true for the albuminoids and nitrogen-free extract.

The result of the Station experience with lucerne or alfalfa may summarized in a few

CONCLUSIONS.

1. That lucerne or alfalfa may be successfully grown in New York State.

2. That when once established it thrives well upon clay land, but will probably do better upon good light loam.

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* Report Wisconsin Ag. Exp. Station, 1885, p. 73.

3. That seed two years old loses its vitality and fails to germinate. Undoubtedly many of the failures to secure a stand of plants may be traced to poor seed.

4. That the seed bed must be well prepared, and, in this latitude, it seems best to plant out the seed in the spring, and with no other crop. The seed should be but lightly covered by rolling the ground.

5. That for seven successive years at the Station three and four cuttings per year have been taken from the plats.

6. That last year, the sixth in succession, the plats yielded more than fifteen tons per acre of green forage, equal to 5.6 tons of alfalfa hay.

7. That alfalfa should be cut in early bloom, before the plants become woody.

8. That it should be cured largely in the cock to produce the best quality of hay.

9. That by chemical analysis the hay was found to be more nitrogenous than good red clover.

10. That cattle, sheep and horses all relished the hay and seemed to do well.

11. That it was found to be more digestible than red clover hay.

12. That if farmers would try this crop we advise them to begin with a small piece of well prepared land, in order to see whether alfalfa does as well with them as it has at the Station.

13. That probably success with alfalfa will depend largely upon having fresh seed, a well prepared seed bed and in covering the seed lightly with soil.

EXPERIMENT II.

PER DAY.	Dry matter.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay eaten	223.18	21.42	70.68	90.91	7.32
Solid excrement	102.07	11.38	38.23	40.45	3.66
Amount digested	121.11	10.04	32.45	50.46	3.66
Per cent digested	54.26	46.87	45.77	55.50	50.00

The nutritive ratio of the above ration was 1 : 9.1.

In this ration of hay not enough was consumed to serve as a maintenance ration and the animal lost slightly in live weight.

EXPERIMENT III.

In this experiment hay, like that used in the last ration, and turnips were fed. The results appear in the next table.

PER DAY.	Dry matter.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
Hay eaten	181.622	15.155	65.269	81.429	5.968
Turnips	12.110	1.377	1.603	7.747	.465
Total eaten	193.732	16.532	66.872	89.176	6.433
Solid excrement	89.470	10.230	32.500	34.380	3.340
Amount digested	104.262	6.302	34.372	54.796	3.093
Per cent digested	53.81	38.12	51.39	61.44	48.08

The nutritive ratio in the above ration proves to be 1 : 19.1. Further we observe that the digestibility of the albuminoids of the hay are considerably depressed, but that the nitrogen-free extract is more fully digested than was the case with the last.

ROOTS IN A RATION.

Influence on the Albuminoids.— It has long been the opinion, based on German investigations, that roots and tubers fed in connection with coarse fodders decrease the digestibility of the albuminoids and crude fiber of the coarse fodders.

This last digestion experiment afforded an opportunity to make some investigations on this particular point. Assuming that the ratio of digestibility for the hay was the same, or approximately so, for the several animals in the trials, and had Star digested her hay equally as well in the ration of hay and turnips as did Spot when fed the same hay alone, then there should have been digested 7.1 ounces of albuminoids plus the albuminoids of the turnips, 1.3 ounces, or a total of 8.4 ounces of albuminoids should have been digested for the ration. In reality only 6.3 ounces of the total albuminoids were digested or 0.8 ounces less than should have been digested in the same amount of hay fed alone. In our trial then the influence of the roots seems to have been to decrease the digestibility of the albuminoids of the hay.

INFLUENCE ON THE CRUDE FIBER AND NITROGEN-FREE EXTRACT.

Assuming, as has been customary, that roots are completely digested, we find Star should have digested from the hay 29.7

ounces and from the turnips 1.6 ounces or a total from the ration of 31.3 ounces. There was digested 34.4 ounces or 3.1 ounces more than should have been digested from the same hay fed alone. Of the nitrogen-free extract there should have been digested 45.2 ounces from the hay, 7.7 ounces from the turnips, a total of 52.9 ounces, but the amount actually digested was 54.8 ounces, so that 1.9 ounces more was digested from the hay than would have been estimated. We may conclude that our results are seemingly in accord with the German:

1. That roots when fed in a ration tend to decrease the digestibility of the albuminoids of the coarse fodders.
2. That the influence of the roots on the nitrogen-free extract of the fodder was to increase the digestibility.

WHAT IS THE ADVANTAGE OF FEEDING ROOTS?

If the addition of roots to a fodder decreases the digestibility of the albuminoids, considered the most valuable portion, then where is the great value to be derived from their use in a ration?

At first this would seem to indicate little or no value for roots and such would be contrary to general observation. Their value, when fed in a ration in moderate quantities, over dry fodder or grain seems, like silage, to be in their power to act as a corrective of the system, thus enabling the animal to put to better use the portion of the food already digested. In other words it prevents the system from becoming clogged, gives tone and vigor to the animal and enables the assimilated food to be used with economy.

EXPERIMENT IV.

As stated, Broad's ration consumed was: Hay, 8.79 pounds; wheat bran, seven pounds; corn meal, four pounds, and cotton-seed meal, three pounds. The next table shows the amounts eaten and digested:

Broad.

PER DAY.	Dry matter.	Albuminoids, Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
Hay eaten	121.340	11.151	39.815	49.570	3.969
Grain eaten	191.360	43.712	13.296	113.152	10.992
Total eaten	312.700	54.863	53.111	162.722	14.968
Solid excrement	95.920	14.570	29.320	36.740	4.690
Amount digested	216.78	40.298	23.791	125.982	10.278
Per cent digested,	69.32	73.44	44.79	77.42	68.66

The nutritive ratio in the last ration proved to be 1:4.3. Assuming that Broad digested the hay in this ration equally as well as did Spot, when fed hay alone, then we may calculate the per cent digested from the grain ration as fed. These results are given in the following table:

Broad — (Digestibility of grain ration).

PER DAY.	Dry matter.	Albuminoids. Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
Total digested	216.780	40.293	23.791	125.982	10.278
Amount digested from hay	71.265	7.595	17.233	27.511	1.984
Grain ration digested	145.515	32.698	6.458	98.471	8.294
Per cent digested	76.03	74.80	48.57	87.02	75.45

EXPERIMENT V.

Whitey receiving a ration made up from grain foods, more largely carbonaceous, consumed per day as follows: Hay, 8.83 pounds; wheat bran, two pounds; corn meal, ten pounds. In the following table are given the data showing the digestibility of such a ration:

Whitey.

	Dry matter.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
Hay eaten	120.760	11.337	38.284	49.309	3.954
Grain eaten	155.554	20.209	4.899	119.329	7.041
Total eaten	276.314	31.546	43.183	168.638	10.995
Solid excrement	68.990	10.410	21.190	27.910	3.270
Amount digested	207.324	21.136	21.993	140.728	7.725
Per cent digested	75.03	67.00	50.93	83.51	70.26

The nutritive ratio for the ration fed Whitey proved to be 1:8.6, just twice as wide a nutritive ratio as in Experiment IV.

As with Broad, assuming that the hay was digested in the same proportion in this ration as when fed alone, we calculate the digestibility of the grain ration as follows:

Whitey (digested of grain ration).

	Dry matter.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
Total digested	207.324	21.136	21.993	140.728	7.725
Amount digested from hay	65.524	5.324	17.522	27.366	1.977
Grain ration digested	141.800	15.812	4.471	113.362	5.748
Per cent digested	68.34	78.24	91.26	94.98	81.63

EXPERIMENT VI.

This experiment conducted with the Jersey cow Nellie, gave an opportunity of determining the digestibility of the following ration per day: Hay, 21.5 pounds; wheat bran, 3.25 pounds; corn meal, 2.2 pounds; cotton-seed meal, 2.2 pounds; linseed meal, 1.1 pounds and oats, 3.25 pounds. The next table shows the digestibility of such a ration.

Nellie.

PER DAY.	Dry matter.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
Hay eaten	300.790	14.007	27.005	95.072	121.925	9.870
Grain eaten	164.540	7.872	36.248	12.096	97.152	9.792
Total	465.330	21.879	63.253	107.168	219.077	19.662
Solid excrement	173.430	14.670	21.990	59.710	71.370	5.740
Amount digested	291.900	7.209	41.263	47.458	147.707	13.922
Per cent digested	62.73	32.95	65.23	44.28	67.42	70.80

The nutritive ratio for the ration proved to be 1 : 5.7, or very nearly the German standard, which is 1 : 5.4.

As in the other trials, calculating the digestibility of the grain ration, the following table is secured:

Nellie digested of grain ration.

	Dry matter.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat.
	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
Total digested	291.900	41.263	47.458	147.707	13.922
Amount digested from hay	163.208	12.572	43.514	67.684	4.935
Grain ration digested	128.692	28.691	3.944	80.023	8.987
Per cent grain digested	78.21	79.15	32.60	82.37	91.78

From the table just given it is evident that Nellie digested very thoroughly her grain ration.

As the sugars and starch have been determined in all the feeds, also in the dry substance of the dung, we may express in ounces the total amount in the food consumed and in the dung also the per cent digested.

Flora.

	Glucose.	Sucrose.	Starch.
In hay eaten	9.68	4.52	41.08
In dung	0	0	17.41
Amount digested	9.68	4.52	23.67
Per cent digested	100	100	68.54

Spot.

	Glucose.	Sucrose.	Starch.
In hay eaten	17.58	5.44	34.68
In dung	0	0	17.84
Amount digested	17.58	5.44	16.84
Per cent digested	100	100	48.56

Star.

	Glucose.	Sucrose.	Starch.
In ration eaten	17.60	5.02	30.76
In dung	0	1.07	12.26
Amount digested	17.60	3.95	18.50
Per cent digested	100	78.68	60.14

Broad.

	Glucose.	Sucrose.	Starch.
In ration eaten	11.60	10.63	103.47
In dung	0	0	14.87
Amount digested	11.60	10.63	88.60
Per cent digested	100	100	85.62

Whitey.

	Glucose.	Sucrose.	Starch.
In ration eaten	10.20	6.63	113.11
In dung	0	0	11.04
Amount digested	10.20	6.63	102.07
Per cent digested	100	100	90.89

Nellie.

	Glucose.	Sucrose.	Starch.
In ration eaten	25.509	12.502	114.819
In dung	0	0	46.740
Amount digested	25.509	12.502	68.079
Per cent digested	100	100	69.42

From the tables presented it is shown that with one exception all of the products in the food reacting like sugars have been digested and a large portion of the starch. The total of sugars and starch digested in each ration falls a little short of the total amount of nitrogen-free extract digested.

AMOUNT OF DUNG PER DAY BY SOME ANIMALS.

As a basis for making an estimate of how much manure will be made by animals during the period of winter feeding, I have brought together the results, secured with different animals, at this Station during the past year. I give the live weight of the animal, the weight of the fresh dung voided per day, also the weight of the water-free substance. The first four animals were cows in milk, the following two heifers, and the last two fattening steers:

	Live weight.	Fresh dung.	Water-free dung.
Jem I	876	40.8	6.30
Jem II	890	44.2	7.40
Meg I	868	37.3	5.70
Meg II	874	47.6	7.40
Flora	972	49.5	8.18
Nellie	1,072	62.6	10.84
Spot	932	37.1	6.37
Star	882	37.4	5.59
Broad	983	35.9	5.99
Whitey	949	27.5	4.31

It is noticeable that the amount of dung per day, either fresh or dry, does not increase in the order of the weight of the animals, but rather is dependent more upon the ration fed.

As we here show the variation in the value of farm manure according to the daily ration fed the animal, I may be pardoned for again stating the ration fed to each animal during these trials:

Jem I. Orchard grass hay, 19.7 pounds; water, 56.8 pounds.

Jem II. Orchard grass hay, 17.7 pounds; corn meal, eight pounds; water, 60.5 pounds.

Meg. I.—Orchard grass hay, 18.3 pounds; water, 56.1 pounds.

Meg. II.—Orchard grass hay, seventeen pounds; corn meal, eight pounds; water, 64.8 pounds.

Flora.—Alfalfa hay, 24.31 pounds; water, 64.6 pounds.

Nellie.—Meadow hay, 21.5 pounds; wheat bran, 3.25 pounds; corn meal, 2.2 pounds; cotton-seed meal, 2.2 pounds; linseed meal, 1.1 pounds; oats, 3.25 pounds; water, 96.1 pounds.

Spot.—Meadow hay 15.87 pounds; turnips, 8.66 pounds; water, 32.2 pounds.

Broad.—Meadow hay, 8.79 pounds; wheat bran, seven pounds; corn meal, four pounds; cotton-seed meal, three pounds; water, 57.4 pounds.

Whitey.—Meadow hay, 8.83 pounds; wheat bran, two pounds; corn meal, ten pounds; water, 38.1 pounds.

The fertilizing matter in the dung of several of the animals was determined by analysis, and below are given the per cent in the fresh substance and in the dry substance.

	JEM AND MEG I.		JEM AND MEG II.		NELLIE.		SPOT.		BROAD.		WHITEY.	
	Per cent in fresh dung.	Per cent in dry dung.	Per cent in fresh dung.	Per cent in dry dung.	Per cent in fresh dung.	Per cent in dry dung.	Per cent in fresh dung.	Per cent in dry dung.	Per cent in fresh dung.	Per cent in dry dung.	Per cent in fresh dung.	Per cent in dry dung.
Ash	1.32	8.81	1.13	7.17	1.49	8.68	1.45	8.45	1.92	11.50	1.34	8.51
Insoluble matter	.583	3.89	.477	3.02	.470	2.74	.478	2.79	.310	1.85	.324	2.06
Nitrogen	.229	1.53	.292	1.85	.350	2.03	.308	1.78	.406	2.43	.398	2.53
Phosphoric acid, P_2O_5	.097	.65	.123	.78	.284	1.66	.139	.81	.695	4.16	.380	2.41
Sulphuric acid, SO_3	....	....	....	....	.048	.28	.029	.17	.030	.18	.038	.25
Potash, K_2O	.195	1.30	.170	1.08	.039	.22	.078	.45	.307	1.84	.138	.87
Lime, CaO	.181	1.21	.164	1.04	.330	1.92	.453	2.64	.313	1.88	.253	1.64
Magnesia, MgO	.006	.04	.052	.33	.046	.27	.065	.38	.142	.85	.073	.46

The amount of these various ash elements, etc., in 2,000 pounds of the different dungs is shown below, expressed in pounds:

	Jem and Meg I.	Jem and Meg II.	Nellie.	Spot.	Broad.	Whitey.
Ash	26.40	22.60	29.80	29.00	38.40	26.80
Insoluble matter	11.66	9.54	9.40	9.56	6.20	6.48
Nitrogen	5.58	5.84	7.00	6.16	8.12	7.96
Phosphoric acid	1.94	2.46	5.78	2.78	13.90	7.60
Sulphuric acid	....	....	.96	.58	.60	.76
Potash	3.90	3.40	.78	1.56	6.14	2.74
Lime	7.68	3.28	6.60	9.06	6.26	5.06
Magnesia	.12	1.04	.92	1.30	2.84	1.46
Value 2,000 pounds	$1 31	$1 38	$1 84	$1 35	$2 64	$2 11

It must be remembered that the dung represented in the above tables is free from all straw or litter of any kind, nor does it include the urine, which is even more valuable than the solids.

The amount of urine per day is shown for the same animals at the same dates as for the dung already given.

		Pounds per day.
Jem	I	16.9
	II	14.9
Meg	I	16.6
	II	14.3
Flora		21.0
Spot		8.9
Star		6.9
Broad		17.9
Nellie		20.5

DAIRY EXPERIMENT.

The chemical work connected with the experiment of the several breeds of animals has of necessity required much time and a large amount of clerical work in calculating and tabulating results. The chemical work, and much of the tabular work, has been done under my supervision by Mr. Whalen, assistant chemist. In the following pages are presented the summary of all results, with such brief discussions of foods, by months and other forms, as seems most desirable for a full understanding of the experiment, up to the month of October.

Foods.

A short description of the foods fed in the trial is essential to a better understanding of the experiment.

Hay.—The hay was a mixture of grasses and clover fed morning and evening until June first, after which date dry hay was fed at noon and green forage the other two feeds.

Beets.—Sugar beets were fed at noon until May tenth. After this date until June first other green forage was substituted.

Alfalfa forage.—This forage was cut from Station grounds, the first crop fed from May tenth to June thirteenth; second crop July fifth to twenty-fifth; third crop August seventeenth to twenty-second, and twenty-sixth to thirty-first. No food fed seemed to be more relished by the animals than partially wilted alfalfa forage. The alfalfa was cut in early bloom.

Rye forage.—Fed from June thirteenth to July fifth and varied from bloom to seed in milk. Rye forage was not well liked by the animals and all were more or less "off-feed."

Maize forage.—Began feeding maize at stage of silking, July thirty-first to August sixth; again August twenty-third to twenty-seventh, in milk, and from September fifteenth to October, when the corn was pretty well glazed.

Oat and pea forage.—Began feeding oat and pea forage when oats were in milk, July twenty-fifth to thirty-first, and again August seventh to tenth.

Hungarian grass.—This grass was fed in bloom from August thirty-first to September fifteenth. The animals did not seem to do so well on Hungarian grass as was expected and for some cause were more or less "off-feed" while this grass was being fed.

The green forages were fed once a day — at noon — up to June first. After this date they were fed morning and evening and hay at noon as previously stated.

Green forages cut each day are very difficult of sampling so as to fairly represent the entire period. The method adopted was to sample so as to represent as nearly as possible an average for the entire period fed and careful analyses made of these samples. The forage, as soon as cut, was taken to barn, weighed and put in pile to wilt for the next day's feeding, and again weighed as fed to animals.

Previous to May fifteen the grains were separately weighed out for each animal. After this date mixtures of 1,000 to 2,000 pounds were made and fed.

Mixture No. 1.—Wheat bran, five parts; linseed meal, three parts, and crushed oats, two parts.

Mixture No. 2.—Wheat bran, five parts; linseed meal, three parts; wheat middlings, two parts.

Mixture No. 4.—Wheat bran, eight parts; crushed oats, six parts; wheat middlings, two parts; linseed meal, three parts; corn meal, one part.

The linseed meal was old-process meal.

The chemical composition of the foods fed is shown by the following tables:

COMPOSITION OF FOODS FED.

FOODS.	Water.	Ash.	Albuminoids Nx 6.25.	Crude fiber.	Nitrogen-free extract.	Fat (ether extract).
Hay, mixed grasses	14.29	4.19	7.88	28.91	41.93	2.80
Hay, mixed grasses	10.17	5.53	11.17	33.21	36.14	3.78
Hay, mixed grasses	21.05	4.49	7.55	26.37	36.48	4.06
Alfalfa	80.91	1.98	4.26	5.15	6.88	.82
Alfalfa	76.72	1.85	4.34	7.15	8.86	1.08
Alfalfa	78.53	1.81	4.61	6.18	7.78	1.09
Beets	83.52	.71	1.91	1.01	12.75	.10
Rye forage	75.69	1.70	3.31	9.01	9.07	1.22
Oat and pea forage	74.81	1.66	3.97	7.98	10.32	1.26
Hungarian grass	73.49	1.72	3.45	7.81	12.43	1.10
Maize forage	91.05	.77	1.32	2.84	3.62	.40
Maize forage	88.05	.78	1.69	3.39	5.44	.65
Maize forage	85.76	.71	1.47	4.04	7.32	.70
Maize forage	77.70	.69	1.47	3.47	16.16	.51
Maize forage	72.18	1.28	2.38	6.09	16.99	1.10
Oats, crushed	12.09	3.00	12.02	10.93	57.20	4.76
Corn meal	9.18	1.26	11.30	1.23	73.04	3.99
Wheat bran	13.01	3.82	16.41	6.19	56.54	4.03
Wheat bran	9.83	5.89	15.50	9.63	56.07	3.08
Wheat middlings	14.66	.85	12.90	1.20	69.29	1.10
Wheat middlings	10.67	1.17	15.52	2.26	68.85	1.53
Linseed meal	8.18	5.56	33.55	8.67	37.44	6.61

SUGARS AND STARCHES.

The per cent of sugars and starches as found in the dry substance of the feeds is as follows:

	Invert sugar.	Sucrose.	Starch.
Hay, mixed grasses	8.00	2.44	15.54
Hay, mixed grasses	2.60	1.28	14.72
Hay, mixed grasses	4.08	1.64	18.54
Alfalfa	2.20	2.16	11.89
Alfalfa	2.04	3.28	17 10
Alfalfa	2.48	2.44	14.96

SUGARS AND STARCHES — (*Continued*).

	Invert sugar.	Sucrose.	Starch.
Beets	6.30	40.92	4.37
Rye forage	4.96	1.04	20.31
Oat and pea forage	3.04	1.76	17.84
Hungarian grass	5.20	3.08	22.00
Maize forage	3.60	.56	17.55
Maize forage	9.76	3.60	15.96
Maize forage	14.32	2.80	15.20
Maize forage	10.00	1.32	24.09
Maize forage	6.80	1.88	36.02
Corn meal	1.28	1.60	76.68
Wheat bran	Tr.	4.40	49.21
Wheat bran	Tr.	5.40	44.40
Wheat middlings	.88	2.12	76.84
Wheat middlings	1.20	2.00	72.48
Linseed meal	0	1.80	22.80
Oats crushed	1.20	1.20	56.24

BREEDS REPRESENTED.

As a few of the animals arrived at the Station the last of March, 1889, the data given begins with the first of April, and tabulated results are given for each animal from the date of their arrival. The ages of the animals in days on April first is given below, also date of arrival at the Station:

	Age in days, April 1, 1889.	Arrived at Station.
HOLSTEIN-FRIESIANS.		
Copia 3d	266	March 28
Esel 2d	293	March 28
Tolsma Artis	334	March 30
Netherland Dowager 4th	327	April 5
Average	305	
AYRSHIRES.		
Queen Duchess	374	April 27
Junietta Peerless	240	May 1
Manton Belle	289	May 2
Miss Flow 5th	366	May 11
Average	317	
AMERICAN HOLDERNESS.		
Nellie 6th	229	April 10
Maggie 6th	234	April 10
Average	231	

BREEDS REPRESENTED — (*Continued*).

	Age in days, April 1, 1889.	Arrived at Station.
GUERNSEYS.		
Rosette Ford	326	May 7
Oriole	219	May 15
Average	273	
JERSEYS.		
Gilderbloom	360	July 16

The weight of the animals for each month, as given, is the average weight for the last five mornings of each month. The animals were weighed in the morning before receiving food or water, and the average results are given below:

WEIGHT OF ANIMALS AT CLOSE OF MONTH.

	April.	May.	June.	July.	Aug.	Sept.
HOLSTEINS.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Copia 3d	564	651	702	726	772	839
Esel 2d	661	741	781	807	812	871
Tolsma Artis	709	768	812	842	878	935
Netherland Dowager	635	709	753	765	806	884
Average	**642**	**717**	**762**	**785**	**817**	**882**
AYRSHIRES.						
Queen Duchess	389	477	537	550	568	627
Junietta Peerless	......	342	393	433	467	522
Manton Belle	......	494	555	607	641	688
Miss Flow	......	641	683	690	735	795
Average	......	**488**	**542**	**570**	**603**	**658**
AMERICAN HOLDERNESS.						
Nellie 6th	372	451	485	513	540	590
Maggie 6th	328	393	429	454	494	552
Average	**350**	**422**	**457**	**483**	**517**	**571**
GUERNSEYS.						
Rosette Ford	......	526	581	601	640	681
Oriole	......	317	368	411	441	489
Average	......	**421**	**474**	**506**	**540**	**585**
JERSEYS.						
Gilderbloom	......	......	......	509	551	586

In the following table are given the total amount of food consumed per month, and the daily average for each animal, and following this the amounts calculated for the chemical composition of the foods for each animal, also the totals up to October. Descriptions of the foods and dates of feeding have already been given and require no further comment.

HOLSTEIN-FRIESIAN — COPIA 3D.

ARRIVED AT STATION, MARCH 28, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	1020.3	34.0	1483.5	47.9	1716.9	57.2	2037.9	65.7	1619.7	52.2	1569.2	52.3	**9447.5**
Hay	226.2	7.5	246.7	8.0	125.7	4.2	123.2	4.0	108.8	3.5	79.3	2.6	**909.9**
Beets	299.5	10.0	100.0	10.0	......	......	......	......	......	......	......	......	**399.5**
Alfalfa forage	......	......	101.0	4.8	230.0	18.4	404.8	20.2	311.1	29.6	......	......	**1046.9**
Rye forage	......	......	......	......	252.9	14.5	60.0	15.0	......	......	......	......	**312.9**
Oat and pea forage	......	......	......	......	......	......	135.0	22.5	59.8	19.9	......	......	**194.8**
Maize forage	......	......	......	......	......	......	24.0	24.0	540.0	31.8	369.0	23.1	**933.0**
Hungarian grass	......	......	......	......	......	......	......	......	14.0	14.0	369.0	26.4	**383.0**
Wheat bran	73.9	2.5	34.3	2.4	......	......	......	......	......	......	......	......	**108.2**
Linseed meal	59.0	2.0	28.0	2.0	......	......	......	......	......	......	......	......	**87.0**
Mixed grains, No. 1	......	......	85.0	5.0	69.4	5.0	......	......	......	......	......	......	**154.4**
Mixed grains, No. 2	......	......	......	......	80.0	5.0	164.5	5.3	120.0	6.0	......	......	**364.5**
Mixed grains, No. 4	......	......	......	......	......	......	......	......	66.0	6.0	134.0	4.5	**200.0**
Increase in live weight and daily gains	73.0	2.40	87.0	2.84	51.0	1.69	24.0	0.77	46.0	1.48	67.0	2.23	**348.0**

HOLSTEIN-FRIESIAN — COPIA 3D.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total.	Daily average.	Total.	Daily average.	Total.	Daily average.	Total.	Daily average.	Total.	Daily average.	Total.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	1020.3	34.0	1483.5	47.9	1716.9	57.2	2037.9	65.7	1619.7	52.2	1569.2	52.3	**9447.5**
Water in food	296.9	9.9	210.5	7.0	397.2	13.2	503.8	16.8	804.2	26.8	595.5	19.8	**2808.1**
Dry matter eaten	361.7	12.0	384.5	12.8	360.8	12.0	407.7	13.6	405.5	13.5	356.1	11.9	**2276.3**
Ash	17.71	.6	20.34	.6	22.89	.6	27.85	.92	26.23	.87	19.29	.64	**134.31**
Albuminoids Nx 6.25	55.44	1.8	59.73	1.9	62.18	2.1	75.24	2.5	74.65	2.5	50.10	1.6	**377.34**
Crude fiber	78.10	2.6	92.07	3.1	87.90	2.9	93.04	3.1	92.80	3.1	80.80	2.7	**524.71**
Nitrogen-free extract	196.89	6.5	196.72	6.5	172.73	5.7	193.25	6.4	201.91	6.7	190.23	6.3	**1151.73**
Fat	13.51	.4	14.99	.5	15.13	.5	18.29	.6	19.92	.66	15.73	.52	**97.57**
Invert sugar	16.09	.53	17.67	.59	12.96	.4	7.69	.25	8.73	.29	15.68	.52	**78.82**
Sucrose	27.12	.9	16.70	.56	9.65	.32	10.67	.35	16.22	.54	9.30	.31	**89.66**
Starch	75.90	2.5	86.94	2.9	91.49	3.0	104.66	3.5	115.25	3.8	99.29	3.3	**573.53**
Albuminoid nitrogen	7.64	.25	7.99	.27	7.80	.26	9.05	.3	9.37	.31	6.23	.21	**48.08**
Amide nitrogen	1.24	.04	1.52	.05	2.12	.07	2.85	.09	2.34	.08	1.54	.05	**11.61**

HOLSTEIN-FRIESIAN — ESEL 2D.

ARRIVED AT STATION, MARCH 28, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	897.1	28.9	1459.6	47.1	1617.1	53.9	1942.5	62.7	1558.4	50.3	1489.3	49.6	8964.0
Hay	244.9	8.2	253.6	8.2	139.2	4.6	138.5	4.5	104.8	3.4	80.1	2.7	961.1
Beets	264.9	9.5	95.3	9.6	......	......	......	......	......	......	......	......	360.2
Alfalfa forage	......	......	99.8	4.8	229.2	18.3	404.8	20.2	310.7	29.6	......	......	1044.5
Rye forage	......	......	......	......	272.3	15.6	59.1	14.8	......	......	......	......	331.4
Oat and pea forage	......	......	......	......	......	......	134.7	22.5	60.7	20.2	......	......	195.4
Maize forage	......	......	......	......	......	......	24.0	24.0	533.3	31.4	366.6	22.9	923.9
Hungarian grass	......	......	......	......	......	......	......	......	13.0	13.0	368.5	26.3	381.5
Wheat bran	61.5	2.1	34.4	2.5	......	......	......	......	......	......	......	......	95.9
Linseed meal	49.2	1.7	28.0	2.0	......	......	......	......	......	......	......	......	77.2
Mixed grains, No. 1	......	......	85.0	5.0	69.6	5.0	......	......	......	......	......	......	154.6
Mixed grains, No. 2	......	......	......	......	80.0	5.0	164.5	5.3	120.0	6.0	......	......	364.5
Mixed grains, No. 4	......	......	......	......	......	......	......	......	62.8	5.7	118.4	3.9	181.2
Increase in live weight and daily gain	33.0	1.10	80.0	2.54	40.0	1.33	26.0	.84	5.0	.16	59.0	1.96	243.0

HOLSTEIN-FRIESIAN — ESEL 2D.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	897.1	28.9	1459.6	47.1	1617.1	53.9	1942.5	62.7	1558.4	50.3	1489.3	49.6	**8964.0**
Water in food	268.2	8.9	206.67	6.8	413.3	13.7	505.7	16.8	797.4	26.6	591.5	19.4	**2782.8**
Dry matter eaten	352.3	11.7	389.5	12.7	377.0	12.9	420.0	14.0	415.5	13.8	342.1	11.4	**2296.4**
Ash	17.23	.6	21.08	.7	23.77	.8	28.49	.94	25.88	.86	18.65	.62	**135.10**
Albuminoids Nx 6.25	50.96	1.7	60.13	2.0	63.96	2.1	76.26	2.5	73.68	2.5	47.30	1.6	**372.29**
Crude fiber	81.54	2.7	93.92	3.1	93:28	3.1	97.16	3.2	91.29	3.0	79.38	2.6	**536.57**
Nitrogen-free extract	189.64	6.3	199.0	6.6	180.18	6.0	198.97	6.6	198.48	6.6	181.64	6.0	**1147.91**
Fat	12.85	.4	15.18	.5	15.74	.5	18.84	.6	19.60	.65	15.09	.5	**97.30**
Invert sugar	17.29	.59	18.14	.6	14.12	.5	9.38	.31	8.54	.28	15.59	.52	**83.06**
Sucrose	24.68	.82	16.33	.54	9.92	.33	11.09	.37	16.00	.53	8.86	.29	**86.88**
Starch	70.73	2.3	87.90	2.9	94.50	3.1	106.77	3.5	113.35	3.8	93.25	3.1	**566.50**
Albuminoid nitrogen	6.96	.23	8.05	.27	8.00	2.7	9.22	.31	9.26	.31	5.85	.19	**47.34**
Amide nitrogen	1.17	.04	1.52	.05	2.19	.07	2.89	.096	2.31	.08	1.49	.05	**11:57**

HOLSTEIN-FRIESIAN — TOLSMA ARTIS

ARRIVED AT STATION, MARCH 30, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	1065.2	35.5	1562.6	50.4	1862.2	62.1	2481.2	80.0	1874.5	60.5	1619.4	54.0	**10465.1**
Hay	252.7	8.4	260.9	8.4	140.0	4.7	146.0	4.7	123.7	4.0	86.8	2.9	**1010.1**
Beets	299.6	10.0	99.6	10.0	......	......	......	......	......	......	......	......	**399.2**
Alfalfa forage	......	......	101.0	4.8	229.1	18.3	404.6	20.2	311.0	29.6	......	......	**1045.7**
Rye forage	......	......	......	......	332.2	19.0	67.6	16.9	......	......	......	......	**399.8**
Oat and pea forage	......	......	......	......	......	......	134.0	22.3	60.3	20.1	......	......	**194.3**
Maize forage	......	......	......	......	......	......	24.0	24.0	536.9	31.6	369.0	23.1	**929.9**
Hungarian grass	......	......	......	......	......	......	......	......	14.0	14.0	365.8	26.1	**379.8**
Wheat bran	73.8	2.5	34.9	2.5	......	......	......	......	......	......	......	......	**108.7**
Linseed meal	58.6	2.0	28.0	2.0	......	......	......	......	......	......	......	......	**86.6**
Mixed grains, No. 1	......	......	85.0	5.0	70.0	5.0	......	......	......	......	......	......	**155.0**
Mixed grains, No. 2	......	......	......	......	80.0	5.0	164.1	5.3	120.0	6.0	......	......	**364.1**
Mixed grains, No. 4	......	......	......	......	......	......	......	......	65.9	6.0	132.8	4.4	**198.7**
Increase in live weight and daily gains	55.0	1.80	59.0	1.93	44.0	1.46	30.0	.97	36.0	1.16	57.0	1.90	**281.0**

HOLSTEIN-FRIESIAN — TOLSMA ARTIS.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	1065.2	35.5	1562.6	50.4	1862.2	62.1	2481.2	80.0	1874.5	60.5	1619.4	54.0	**10465.1**
Water in food	300.7	10.0	212.3	7.0	458.8	15.3	513.2	17.1	804.8	26.8	594.0	19.8	**2883.8**
Dry matter eaten	384.7	12.8	397.1	13.2	392.5	13.1	426.1	14.2	427.0	14.0	360.4	12.0	**2387.8**
Ash	18.79	.6	20.99	.70	248.5	.83	28.95	.96	26.87	.89	19.54	.65	**139.99**
Albuminoids Nx 6.25	57.40	1.9	60.93	2.0	66.08	2.2	77.09	2.6	75.62	2.5	50.34	1.7	**387.46**
Crude fiber	85.72	2.8	96.25	3.2	98.95	3.3	99.81	3.3	96.73	3.2	82.58	2.7	**560.04**
Nitrogen-free extract	207.86	6.9	203.0	6.7	186.12	6.2	202.12	6.7	207.14	6.9	191.95	6.4	**1198.19**
Fat	14.21	.5	15.41	.5	16.51	.5	19.22	.6	20.52	.68	15.95	.53	**101.82**
Invert sugar	17.90	.6	18.65	.6	14.88	.5	9.71	.32	9.20	.31	15.90	.53	**86.24**
Sucrose	37.65	1.2	16.99	.56	10.12	.33	11.19	.37	16.73	.56	9.34	.31	**102.02**
Starch	79.32	2.6	84.10	2.8	97.71	3.2	108.08	3.9	117.35	3.9	99.74	3.3	**586.30**
Albuminoid nitrogen	7.89	.26	8.15	.27	8.24	.27	9.36	.31	8.51	.28	6.25	.21	**48.40**
Amide nitrogen	1.30	.04	1.55	.05	2.31	.08	2.91	.10	2.38	.08	1.55	.05	**12.00**

HOLSTEIN-FRIESIAN — NETHERLAND DOWAGER 4TH.

ARRIVED AT STATION, APRIL 5, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	879.1	33.8	1401.5	45.2	1485.1	49.5	1801.7	58.1	1445.2	46.6	1402.8	46.8	8415.4
Hay	179.9	6.9	229.2	7.4	130.4	4.3	117.6	3.8	99.5	3.2	76.5	2.5	833.1
Beets	239.5	9.6	99.5	10.0	......	......	......	......	......	......	......	......	339.0
Alfalfa forage	......	......	100.9	4.8	229.5	18.4	393.3	19.7	305.4	29.1	......	......	1029.1
Rye forage	......	......	......	......	256.7	14.7	52.1	13.0	......	......	......	......	308.8
Oat and pea forage	......	......	......	......	......	......	122.7	20.4	56.0	18.7	......	......	178.7
Maize forage	......	......	......	......	......	......	21.8	21.8	527.8	31.0	361.7	22.6	911.3
Hungarian forage	......	......	......	......	......	......	......	......	13.3	13.3	355.9	25.4	369.2
Wheat bran	61.0	2.4	33.8	2.4	......	......	......	......	......	......	......	......	94.8
Linseed meal	49.8	2.0	28.0	2.0	......	......	......	......	......	......	......	......	77.8
Mixed grains, No. 1	......	......	85.0	5.0	70.0	5.0	......	......	......	......	......	......	155.0
Mixed grains, No. 2	......	......	......	......	80.0	5.0	164.5	5.3	120.0	6.0	......	......	364.5
Mixed grains, No. 4	......	......	......	......	......	......	......	......	66.0	6.0	134.0	4.5	200.0
Increase in live weight and daily gain	73.0	2.40	74.0	2.39	44.0	1.46	12.0	.42	41.0	1.32	78.0	2.60	322.0

HOLSTEIN-FRIESIAN — NETHERLAND DOWAGER 4TH.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	879.1	33.8	1401.5	45.2	1485.1	49.5	1801.7	58.1	1445.2	46.6	1402.8	46.8	**8415.4**
Water in food	237.7	7.9	207.4	6.9	400.5	13.3	477.7	15.9	884.0	29.5	579.6	19.3	**2786.9**
Dry matter eaten	292.5	9.7	369.8	12.3	366.1	12.2	394.3	13.1	304.0	10.0	347.5	11.6	**2074.2**
Ash	14.33	.5	20.08	.6	23.16	.8	26.91	.9	25.50	.85	18.85	.63	**128.83**
Albuminoids	45.47	1.5	58.25	1.9	62.85	2.1	73.27	2.4	73.21	2.4	49.22	1.6	**362.27**
Crude fiber	62.51	2.0	86.92	2.9	89.57	2.9	88.98	2.9	89.07	2.9	78.58	2.6	**495.63**
Nitrogen-free extract	159.10	5.3	189.06	6.3	175.15	5.8	187.74	6.2	190.88	6.3	186.44	6.2	**1088.37**
Fat	11.03	.3	14.49	.5	15.33	.5	17.65	.6	19.31	.64	15.38	.51	**93.19**
Invert sugar	12.80	.42	15.47	.51	13.33	.4	8.24	.27	8.30	.28	15.25	.51	**73.39**
Sucrose	21.78	.72	15.31	.51	9.74	.32	10.63	.35	13.90	.46	9.12	.30	**80.48**
Starch	61.97	2.1	86.38	2.9	98.71	3.3	102.81	3.4	113.18	3.8	97.67	3.2	**560.72**
Albuminoid nitrogen	6.26	.21	7.81	.26	7.89	.26	8.87	.29	9.21	.31	6.11	.2	**46.15**
Amide nitrogen	1.00	.03	1.49	.05	2.15	.07	2.75	.09	2.31	.08	1.47	.05	**11.17**

AYRSHIRE — QUEEN DUCHESS.

ARRIVED AT STATION, APRIL 27, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	942.5	30.4	1113.4	37.1	1410.6	45.5	974.5	31.4	1053.9	35.1	**5494.9*****
Hay	......	......	179.7	5.8	129.8	4.3	155.0	5.0	96.9	3.1	67.7	2.3	**629.1**
Beets	......	......	50.0	5.0	......	......	......	......	......	......	......	......	**50.0**
Alfalfa forage	......	......	58.8	2.8	155.0	12.4	366.8	18.3	307.2	29.3	......	......	**887.8**
Rye forage	......	......	......	......	216.3	12.4	38.3	9.6	......	......	......	......	**254.6**
Oat and pea forage	......	......	......	......	......	......	118.3	19.7	48.6	16.2	......	......	**166.9**
Maize forage	......	......	......	......	......	......	20.0	20.0	503.3	29.6	365.0	22.8	**888.3**
Hungarian grass	......	......	......	......	......	......	......	......	14.0	14.0	365.0	26.1	**379.0**
Wheat bran	......	......	13.9	1.0	......	......	......	......	......	......	......	......	**13.9**
Linseed meal	......	......	14.0	1.0	......	......	......	......	......	......	......	......	**14.0**
Mixed grains, No. 1	......	......	68.0	4.0	56.0	4.0	......	......	......	......	......	......	**124.0**
Mixed grains, No. 2	......	......	......	......	64.0	4.0	124.0	4.0	80.0	4.0	......	......	**268.0**
Mixed grains, No. 4	......	......	......	......	......	......	......	......	44.0	4.0	121.0	4.0	**165.0**
Oat meal	......	......	12.5	1.0	......	......	......	......	......	......	......	......	**12.5**
Increase in live weight and daily gains	......	......	86.0	2.80	58.0	1.90	13.0	.71	18.0	.58	59.0	1.97	**234.0**

* The amount of water drank in April is not included.

AYRSHIRE—QUEEN DUCHESS.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	38.0	12.7	942.5	30.4	1113.4	37.1	1410.6	45.5	974.5	31.4	1053.9	35.1	**5532.9**
Water in food	3.86	.7	123.0	4.1	310.8	10.3	435.9	14.5	752.2	25.0	586.4	19.5	**2212.16**
Dry matter eaten	26.9	5.4	274.2	9.1	310.3	10.3	358.9	11.6	341.8	11.4	332.4	11.1	**1644.5**
Ash	1.26	.2	15.01	.5	19.05	.6	24.79	.8	22.22	.7	18.05	.6	**100.38**
Albuminoids Nx 6.25	4.16	.8	41.85	1.4	51.07	1.7	64.39	2.1	60.14	2.0	46.58	1.51	**267.39**
Crude fiber	5.99	1.2	66.16	2.2	77.99	2.6	86.06	2.9	81.83	2.7	75.67	2.5	**393.70**
Nitrogen-free extract	14.31	2.9	141.44	4.7	149.37	4.9	167.56	5.6	160.99	5.3	177.51	5.9	**811.18**
Fat	1.01	.2	10.58	.4	12.80	.4	16.07	.53	16.58	.55	14.63	.49	**71.67**
Invert sugar	1.23	.2	12.89	.43	12.38	.4	8.55	.28	8.01	.27	15.08	.5	**58.14**
Sucrose	.59	.1	10.34	.34	8.07	.27	9.28	.31	13.60	.45	8.72	.29	**50.60**
Starch	7.51	1.5	74.89	2.5	77.25	2.6	74.62	2.5	87.93	2.9	91.99	3.0	**414.19**
Albuminoid nitrogen	.59	.1	5.54	.18	6.46	.21	7.62	.25	7.39	.25	5.77	.19	**33.37**
Amide nitrogen	.14	.03	1.02	.03	1.68	.05	2.59	.08	2.08	.07	1.44	.05	**8.95**

AYRSHIRE — MANTON BELLE.

ARRIVED AT STATION, MAY 2, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	1057.6	35.3	1396.8	46.6	1888.6	60.9	1375.5	44.4	1309.4	43.6	7027.0
Hay	......	......	189.8	6.3	129.1	4.3	144.2	4.7	123.8	4.0	88.1	2.9	675.9
Beets	......	......	41.9	4.7	......	......	......	......	......	......	......	......	41.9
Alfalfa forage	......	......	59.0	2.8	154.3	12.3	366.6	18.3	309.8	29.5	......	......	889.6
Rye forage	......	......	......	......	243.3	13.9	55.3	13.8	......	......	......	......	298.2
Oat and pea forage	......	......	......	......	......	......	118.5	19.7	50.7	16.9	......	......	169.0
Maize forage	......	......	......	......	......	......	20.0	20.0	512.0	30.1	369.0	23.1	901.0
Hungarian grass	......	......	......	......	......	......	......	......	14.0	14.0	368.6	26.3	382.6
Wheat bran	......	......	13.0	1.0	......	......	......	......	......	......	......	......	13.0
Linseed meal	......	......	13.0	1.0	......	......	......	......	......	......	......	......	13.0
Mixed grains, No. 1	......	......	68.0	4.0	56.0	4.0	......	......	......	......	......	......	124.0
Mixed grains, No. 2	......	......	......	......	64.0	4.0	124.0	4.0	80.0	4.0	......	......	268.0
Mixed grains, No. 4	......	......	......	......	......	......	......	......	44.0	4.0	121.0	4.0	165.0
Oat meal	......	......	11.5	1.0	......	......	......	......	......	......	......	......	11.5
Increase in live weight and daily gains	......	......	......	......	61.0	2.0	52.0	1.68	34.0	1.09	47.0	1.57	194.0

AYRSHIRE — MANTON BELLE.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	1057.6	35.3	1396.8	46.6	1888.6	60.9	1375.5	44.4	1309.4	43.6	**7027.9**
Water in food	......	......	117.5	3.9	330.6	11.0	456.8	15.2	760.5	25.3	595.0	19.8	**2260.4**
Dry matter eaten	......	......	278.7	9.3	316.1	10.5	371.8	12.4	333.1	10.9	351.7	11.7	**1651.4**
Ash	......	......	14.65	.5	19.47	.64	25.38	.84	21.76	.7	19.15	.6	**100.41**
Albuminoids Nx 6.25	......	......	40.87	1.3	51.86	1.7	65.23	2.2	59.48	1.9	48.46	1.6	**265.90**
Crude fiber	......	......	68.79	2.3	80.16	2.7	90.85	3.0	78.84	2.6	82.08	2.7	**400.72**
Nitrogen-free extract	......	......	143.3	4.8	151.45	5.0	173.51	5.8	156.92	5.2	186.45	6.2	**811.63**
Fat	......	......	10.68	.3	14.32	.5	16.78	.56	16.12	.54	15.60	.5	**73.50**
Invert sugar	......	......	13.56	.45	12.67	.4	9.17	.3	7.61	.25	15.92	.53	**58.93**
Sucrose	......	......	9.88	.33	8.12	.27	9.40	.31	13.54	.45	9.05	.30	**49.99**
Starch	......	......	65.13	2.2	78.10	2.6	89.84	3.0	86.29	2.9	95.61	3.2	**414.97**
Albuminoid nitrogen	......	......	5.53	.18	6.55	.21	7.71	.26	7.30	.24	6.01	.20	**33.10**
Amide nitrogen	......	......	1.03	.03	1.73	.06	2.61	.08	2.06	.07	1.52	.05	**8.95**

AYRSHIRE — JUNIETTA PEERLESS.

ARRIVED AT STATION, MAY 1, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	797.0	26.6	1073.5	37.8	1411.0	45.5	996.5	32.1	1120.0	37.3	5398.0
Hay	......	......	135.8	4.4	99.6	3.3	104.8	3.4	83.1	2.7	50.0	1.7	473.3
Beets	......	......	16.5	1.8	......	......	......	......	......	......	......	......	16.5
Alfalfa forage	......	......	59.0	2.8	155.0	12.4	365.8	18.3	268.1	25.5	......	......	847.9
Rye forage	......	......	......	......	225.2	12.9	44.8	11.2	......	......	......	......	270.0
Oat and pea forage	......	......	......	......	......	......	119.4	19.9	45.9	15.3	......	......	165.3
Maize forage	......	......	......	......	......	......	20.0	20.0	471.9	27.8	305.0	19.1	796.9
Hungarian forage	......	......	......	......	......	......	......	......	12.0	12.0	311.8	22.3	323.8
Wheat bran	......	......	7.7	.6	......	......	......	......	......	......	......	......	7.7
Linseed meal	......	......	8.2	.6	......	......	......	......	......	......	......	......	8.2
Mixed grains, No. 1	......	......	55.6	3.3	55.8	4.0	......	......	......	......	......	......	111.4
Mixed grains, No. 2	......	......	......	......	63.6	4.0	123.9	4.0	80.0	4.0	......	......	267.5
Mixed grains, No. 4	......	......	......	......	......	......	......	......	44.0	4.0	121.0	4.0	165.0
Oat meal	......	......	8.1	.6	......	......	......	......	......	......	......	......	8.1
Increased in live weight and daily gain	......	......	44.0	1.60	52.0	1.70	40.0	1.29	34.0	1.09	55.0	1.83	225.0

AYRSHIRE — JUNIETTA PEERLESS.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	797.0	26.6	1073.5	35.8	1411.0	45.5	996.5	32.1	1120.0	37.3	**5398.0**
Water in food	......	......	85.88	2.8	313.2	10.4	441.1	14.7	689.2	22.9	495.6	16.5	**2017.98**
Dry matter eaten	......	......	155.0	5.2	287.6	9.6	357 6	11.9	315.8	10.0	292.2	9.7	**1408.2**
Ash	......	......	11.13	.37	17.94	.59	23.45	.78	20.37	.67	15.73	.5	**88.62**
Albuminoids Nx 6.25	......	......	30.89	1.0	48.96	1.63	61.85	2.0	56.16	1.9	42.17	1.4	**240.03**
Crude fiber	......	......	50.71	1.7	70.05	2.3	79.27	2.6	73.70	2.4	63.78	2.1	**337.51**
Nitrogen-free extract	......	......	104.31	3.5	137.51	4.6	157.87	5.2	150.37	5.0	157.40	5.2	**707.46**
Fat	......	......	7.98	.3	12.08	.4	15.15	.5	15.23	.5	12.82	.42	**63.26**
Invert sugar	......	......	9.77	.32	10.43	.35	7.50	.25	7.11	.24	12.57	.42	**47.38**
Sucrose	......	......	6.81	.23	7.42	.25	8.87	.29	12.84	.43	7.49	.25	**43.43**
Starch	......	......	46.52	1.5	73.67	2.4	83.64	2.8	83.47	2.8	83.85	2.8	**371.15**
Albuminoid nitrogen	......	......	4.14	.14	6.18	.2	7.34	.24	6.94	.23	5.24	.17	**29.84**
Amide nitrogen	......	......	.84	.03	1.66	.05	2.48	.08	1.87	.06	1.26	.04	**8.11**

AYRSHIRE — MISS FLOW 5TH.

ARRIVED AT STATION, MAY 11, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	863.7	41.1	1400.5	46.7	1845.2	59.5	1274.6	41.1	1178.0	39.3	**6562.0**
Hay	......	......	161.1	7.7	132.1	4.4	123.8	4.0	98.0	3.2	66.3	2.2	**581.3**
Beets	......	......	......	......	......	......	......	......	......	......	......	......	....
Alfalfa forage	......	......	97.0	4.8	229.3	17.5	400.0	20.0	308.9	29.4	......	......	**1035.2**
Rye forage	......	......	......	......	322.4	18.4	69.2	17.3	......	......	......	......	**391.6**
Oat and pea forage	......	......	......	......	......	......	131.3	21.9	59.2	19.7	......	......	**190.5**
Maize forage	......	......	......	......	......	......	22.0	22.0	522.0	30.7	369.0	23.1	**913.0**
Hungarian grass	......	......	......	......	......	......	......	......	14.0	14.0	368.6	26.3	**382.6**
Wheat bran	......	......	......	......	......	......	......	......	......	......	......	......	....
Linseed meal	......	......	......	......	......	......	......	......	......	......	......	......	....
Mixed grains, No. 1	......	......	85.0	5.0	70.0	5.0	......	......	......	......	......	......	**155.0**
Mixed grains, No. 2	......	......	......	......	80.0	5.0	164.5	5.3	119.8	6.0	......	......	**364.3**
Mixed grains, No. 4	......	......	......	......	......	......	......	......	66.0	6.0	135.0	4.5	**201.0**
Increase in live weight and daily gain	......	......	......	......	45.0	1.50	7.0	.29	45.0	1.45	60.0	2.00	**157.0**

Ayrshire — Miss Flow 5th.

	April.		May.		June.		July.		August.		September.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	863.7	41.1	1400.5	46.7	1845.2	59.5	1274.6	44.1	1178.0	39.3	6562.0
Water in food	......	......	106.23	5.0	450.2	15.0	502.9	16.7	760.5	25.3	593.5	19.8	2413.33
Dry matter eaten	......	......	248.4	11.0	383.8	12.8	407.9	13.6	463.0	15.4	345.4	11.5	1848.5
Ash	......	......	14.11	.7	24.34	.8	27.83	.9	24.72	.8	18.67	.6	109.67
Albuminoids Nx 6.25	......	......	38.67	1.8	65.14	2.2	75.10	2.5	70.22	2.3	49.14	1.6	298.27
Crude fiber	......	......	62.36	3.0	95.82	3.2	93.34	3.1	90.05	3.0	77.05	2.6	418.62
Nitrogen-free extract	......	......	123.31	6.0	181.95	6.0	193.36	6.4	198.14	6.6	185.41	6.2	882.17
Fat	......	......	9.49	.5	16.17	.54	18.29	.6	20.82	.69	15.17	.5	79.94
Invert sugar	......	......	11.58	.5	14.24	.47	8.80	.22	8.67	.29	12.22	.4	55.51
Sucrose	......	......	7.24	.4	9.95	.33	10.83	.36	14.71	.49	9.13	.3	51.86
Starch	.....	......	82.79	3.9	96.19	3.2	105.23	3.5	108.07	3.6	97.47	3.2	489.75
Albuminoids	......	......	5.10	.17	8.13	.27	9.07	.3	8.87	.29	6.10	.2	37.27
Amide nitrogen	......	......	1.06	.03	2.29	.07	2.75	.09	2.35	.08	1.49	.05	9.94

AMERICAN HOLDERNESS — NELLIE 6TH.

ARRIVED AT STATION, APRIL 10, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	250.0	13.2	947.7	30.6	1085.8	36.2	1502.8	48.4	1245.8	40.2	1158.5	38.6	6190.6
Hay	57.2	2.7	140.0	4.5	101.5	3.4	89.3	2.9	56.7	1.8	43.9	1.5	488.6
Beets	15.0	5.0	50.0	5.0	......	......	......	......	......	......	......	......	65.0
Alfalfa forage	......	......	58.3	2.8	154.9	12.4	363.1	18.1	260.0	24.8	......	......	836.3
Rye forage	......	......	......	......	170.3	9.7	16.0	4.0	......	......	......	......	186.3
Oat and pea forage	......	......	......	......	......	......	115.4	19.2	440.0	14.7	......	......	555.4
Maize forage	......	......	......	......	......	......	19.9	19.9	467.3	27.5	302.7	18.9	789.9
Hungarian grass	......	......	......	......	......	......	......	......	9.9	9.9	287.4	20.5	297.3
Wheat bran	20.5	1.0	13.9	1.0	......	......	......	......	......	......	......	......	34.4
Linseed meal	18.8	.9	14.0	1.0	......	......	......	......	......	......	......	......	32.8
Mixed grains, No. 1	......	......	67.9	4.0	56.0	4.0	......	......	......	......	......	......	123.9
Mixed grains, No. 2	......	......	......	......	64.0	4.0	124.0	4.0	80.0	4.0	......	......	268.0
Mixed grains, No. 4	......	......	......	......	......	......	......	......	44.0	4.0	121.0	4.0	165.0
Oat meal	20.5	1.0	12.5	1.0	......	......	......	......	......	......	......	......	33.0
Increase in live weight and daily gains	......	......	75.0	2.55	34 0	1.10	28.0	.87	27.0	.87	58.0	1.93	222.0

AMERICAN HOLDERNESS — NELLIE 6TH.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	250.0	13.2	947.7	30.6	1085.8	36.2	1502.8	48.4	1245.8	40.2	1158.5	38.6	**6190.6**
Water in food	26.7	1.3	117.1	3.9	271.90	9.0	461.2	15.4	670.8	21.9	475.8	15.8	**2023.5**
Dry matter eaten	105.3	5.0	249.7	8.3	274.8	9.1	276.5	9.2	291.1	9.6	279.2	9.3	**1476.6**
Ash	4.79	.2	12.82	.4	17.07	.57	20.49	.68	18.90	.62	14.96	.49	**89.03**
Albuminoids	16.91	.8	47.95	1.6	47.31	1.6	57.55	1.9	53.44	1.8	40.70	1.3	**263.86**
Crude fiber	21.15	1.0	54.64	1.8	65.64	2.3	53.61	1.8	65.52	2.1	59.82	1.9	**320.38**
Nitrogen-free extract	57.65	2.7	124.89	4.1	133.68	4.4	123.32	4.1	139.27	4.5	151.45	5.0	**730.26**
Fat	4.43	.2	9.43	.3	11.45	.4	11.74	.4	13.98	.45	12.24	.4	**63.18**
Invert sugar	4.20	.2	10.06	.33	9.88	.33	3.34	.11	6.15	.20	11.95	.39	**45.58**
Sucrose	3.17	.16	9.54	.31	7.39	.24	7.68	.25	12.27	.40	7.49	.25	**47.54**
Starch	31.04	1.6	59.58	1.9	71.21	2.3	69.59	2.3	78.96	2.6	81.23	2.7	**391.61**
Albuminoid nitrogen	2.46	.12	5.11	.17	6.01	.20	6.73	.22	6.60	.22	5.07	.17	**31.98**
Amide nitrogen	.29	.01	.96	.03	1.53	.05	2.49	.08	1.70	.06	1.20	.04	**8.17**

AMERICAN HOLDERNESS — MAGGIE 6TH.

ARRIVED AT STATION, APRIL 10, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	250.0	13.2	1002.6	32.3	1286.2	42.9	1536.2	49.6	1177.6	40.0	1059.6	35.3	6312.2
Hay	59.2	2.8	125.6	4.1	91.8	3.1	87.9	2.8	76.3	2.5	51.5	1.7	492.3
Beets	15.0*	5.0	50.0	5.0	......	......	......	......	......	......	......	......	65.0
Alfalfa forage	......	......	58.3	2.8	154.1	12.3	359.4	18.0	265.8	25.3	......	......	837.6
Rye forage	......	......	......	......	166.3	9.5	30.2	7.5	......	......	......	......	196.5
Oat and pea forage	......	......	......	......	......	......	105.0	17.5	39.5	13.2	......	......	144.5
Maize forage	......	......	......	......	......	......	13.3	13.3	424.6	25.0	300.7	18.8	738.6
Hungarian forage	......	......	......	......	......	......	......	......	11.7	11.7	306.8	21.9	318.5
Wheat bran	20.4	1.0	13.9	1.0	......	......	......	......	......	.....	......	......	34.3
Linseed meal	18.5	.9	14.0	1.0	......	......	......	......	......	......	......	......	32.5
Mixed grains, No. 1	......	......	68.0	4.0	55.1	3.9	......	......	......	......	......	......	123.1
Mixed grains, No. 2	......	......	......	......	64.0	4.0	124.0	4.0	80.0	4.0	......	......	268.0
Mixed grains, No. 4	......	......	......	......	......	......	......	......	44.0	4.0	121.0	4.0	165.0
Oat meal	20.4	1.0	14.5	1.0	......	......	......	......	......	......	......	......	31.9
Increase in live weight and daily gain	......	......	65.0	2.09	36.0	1.20	25.0	.81	41.0	1.32	50.0	1.67	217.0

AMERICAN HOLDERNESS — MAGGIE 6TH.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	250.0	13.2	1002.6	32.3	1286.2	42.9	1536.2	49.6	1177.6	40.0	1059.6	35.3	**6312.2**
Water in food	27.06	1.3	114.9	3.8	266.8	8.9	405.8	13.5	639.2	20.7	488.9	16.3	**1942.66**
Dry matter eaten	106.44	5.0	226.4	7.6	264.5	8.8	314.0	10.5	302.7	10.0	291.1	9.7	**1505.14**
Ash	4.95	2.0	12.22	.4	16.54	.55	21.95	.73	19.52	.64	15.68	.52	**90.86**
Albuminoids Nx 6.25	16.93	.8	35.83	1.2	46.17	1.5	58.96	1.9	54.46	1.8	42.04	1.4	**254.39**
Crude fiber	21.67	1.0	50.48	1.7	62.34	2.1	71.37	2.7	68.56	2.2	63.63	2.1	**338.05**
Nitrogen-free extract	58.28	2.8	118.87	3.9	128.37	4.3	147.80	4.9	144.62	4.8	156.92	5.2	**754.86**
Fat	4.41	.20	9.04	.30	11.09	.37	13.92	.46	14.58	.48	12.79	.42	**65.83**
Invert sugar	4.34	.2	9.18	.3	9.17	.31	6.64	.22	6.65	.22	10.46	.35	**46.44**
Sucrose	3.21	.16	9.26	.31	7.16	.24	8.40	.28	12.02	.4	7.76	.26	**47.81**
Starch	31.20	1.6	57.70	1.9	69.38	2.3	79.29	2.6	81.10	2.7	83.64	2.8	**402.29**
Albuminoid nitrogen	2.46	.12	4.97	.16	6.07	.20	7.52	.25	6.76	.22	5.23	.17	**33.01**
Amide nitrogen	.29	.01	.93	.03	1.50	.05	2.34	.08	1.81	.06	1.25	.04	**8.12**

GUERNSEY — ROSETTE FORD.

ARRIVED AT STATION, MAY 7, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	1055.6	42.2	1472.7	49.1	1852.6	59.8	1423.0	45.9	1356.9	45.2	7160.8
Hay	......	......	166.8	6.7	128.2	4.3	140.6	4.5	113.6	3.7	78.1	2.6	627.3
Beets	......	......	18.5	4.6	......	......	......	......	......	......	......	......	18.5
Alfalfa forage	......	......	91.0	4.3	214.5	17.2	397.3	19.9	309.1	29.4	......	......	1011.9
Rye forage	......	......	......	......	312.8	17.9	63.2	15.8	......	......	......	......	376.0
Oat and pea forage	......	......	......	......	......	......	120.9	20.1	48.0	16.0	......	......	168.9
Maize forage	......	......	......	......	......	......	22.0	22.0	527.9	31.1	369.0	23.1	918.9
Hungarian grass	......	......	......	......	......	......	......	......	13.8	13.8	367.6	26.3	381.4
Wheat bran	......	......	8.3	1.0	......	......	......	......	......	......	......	......	8.3
Linseed meal	......	......	8.0	1.0	......	......	......	......	......	......	.....	......	8.0
Mixed grains, No. 1	......	......	84.9	5.0	69.0	5.0	......	......	......	......	......	......	154.5
Mixed grains, No. 2	......	......	......	......	80.0	5.0	154.8	5.0	100.0	5.0	......	......	334.8
Mixed grains, No. 4	......	......	......	......	......	......	......	......	55.0	5.0	123.9	4.1	178.9
Oat meal	......	......	6.0	.9	......	......	......	......	......	......	......	......	6.0
Increase in live weight and daily gains	......	......	......	......	55.0	1.83	20.0	.64	39.0	1.25	41.0	1.37	155.0

GUERNSEY — ROSETTE FORD.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	1055.6	42.2	1472.7	49.1	1852.6	59.8	1423.0	45.9	1356.9	45.2	**7160.8**
Water in food	......	......	119.02	2.5	431.4	14.4	491.5	16.4	781.7	26.0	593.2	19.8	**2416.82**
Dry matter eaten	......	......	264.5	13.5	373.7	16.7	407.3	13.6	385.7	12.8	345.4	11.5	**1776.6**
Ash	......	......	14.72	6.1	23.62	.79	27.71	.92	24.61	.82	18.76	.62	**109.42**
Albuminoids Nx 6.25	......	......	41.23	1.8	63.59	2.1	73.49	2.4	67.96	2.2	48.10	1.6	**294.37**
Crude fiber	......	......	64.62	2.7	92.81	3.1	95.38	3.2	89.74	2.9	79.36	2.6	**421.91**
Nitrogen-free extract	......	......	133.67	5.5	178.12	5.9	192.38	6.4	184.77	6.1	183.93	6.1	**872.87**
Fat	......	......	10.30	.41	15.79	.5	18.29	.6	18.66	.6	15.24	.5	**78.28**
Invert sugar	......	......	12.05	.5	13.77	.46	10.31	.34	8.69	.29	15.57	.52	**60.39**
Sucrose	......	......	8.59	.34	9.74	.32	10.62	.35	14.98	.49	8.97	.29	**52.90**
Starch	......	......	63.70	2.6	93.81	3.1	102.86	3.4	102.91	3.4	95.04	3.1	**458.32**
Albuminoid nitrogen	......	......	5.46	.22	8.27	.27	8.83	.29	8.46	.28	5.96	.19	**36.98**
Amide nitrogen	......	......	1.09	.04	2.16	.07	3.04	.10	2.26	.07	1.49	.05	**10.04**

GUERNSEY — ORIOLE.

ARRIVED AT STATION, MAY 15, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	570.2	33.5	1337.6	44.6	1556.5	50.2	1243.6	40.1	1223.9	40.8	5931,8
Hay	......	......	89.3	5.2	109.6	3.7	107.5	3.5	86.9	2.8	55.8	1.8	449,1
Beets	......	......	......	......	......	......	......	......	......	......	......	......	....
Alfalfa forage	......	......	47.0	2.9	154.3	12.3	364.6	18.2	258.0	24.6	......	......	823.9
Rye forage	......	......	......	......	208.0	11.9	47.7	11.9	......	......	......	......	255.7
Oat and pea forage	......	......	......	......	......	......	116.8	19.5	41.9	14.0	......	......	158.7
Maize forage	......	......	......	......	......	......	15.9	15.9	449.3	26.4	297.7	18.6	762.9
Hungarian grass	......	......	......	......	......	......	......	......	12.0	12.0	311.1	22.2	323.1
Wheat bran	......	......	......	......	......	......	......	......	......	......	......	......	....
Linseed meal	......	......	......	......	......	......	......	......	......	......	......	......	....
Mixed grains, No. 1	......	......	56.0	3.3	56.0	4.0	......	......	......	......	......	......	112.0
Mixed grains, No. 2	......	......	......	......	64.0	4.0	122.9	4.0	79.8	4.0	......	......	266.7
Mixed grains, No. 4	......	......	......	......	......	......	......	......	44.4	4.0	115.9	3.9	159.9
Increase in live weight and daily gain	......	......	......	......	52.0	1.70	43.0	1 38	30.0	.97	48.0	1.60	173.0

GUERNSEY — ORIOLE.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	570.2	33.5	1337.6	44.6	1556.5	50.2	1243.6	40.1	1223.9	40.8	**5931.8**
Water in food	......	......	53.95	3.2	301.1	10.0	437.2	14.6	659.6	21.9	489.5	16.3	**1941.35**
Dry matter eaten	......	......	138.4	8.1	290.7	9.7	338.2	11.3	312.3	10.4	291.0	9.7	**1370.6**
Ash	......	......	7.86	4.6	18.05	.6	23.46	.78	20.04	.67	15.75	.52	**85.16**
Albuminoids	......	......	21.34	1.3	49.16	1.6	61.75	2.0	53.26	1.8	41.59	1.38	**227.10**
Crude fiber	......	......	34.52	2.0	71.34	2.4	79.74	2.6	72.81	2.4	64.67	2.1	**323.08**
Nitrogen-free extract	......	......	69.17	4.0	140.07	4.7	158.16	5.3	149.10	4.9	156.16	5.2	**672.66**
Fat	......	......	5.42	.3	12.13	.4	15.13	.5	15.08	.5	12.78	.4	**60.54**
Invert sugar	......	......	6.39	.4	10.89	.36	7.70	.26	7.05	.23	12.61	.42	**44.64**
Sucrose	......	......	4.13	.2	7.75	.26	8.83	.29	13.34	.44	7.63	.25	**41.68**
Starch	......	......	33.27	1.9	74.14	2.5	73.51	2.4	84.38	2.8	82.56	2.7	**347.86**
Albuminoid nitrogen	......	......	2.88	.14	6.22	.21	7.32	.24	6.79	.23	5.17	.17	**28.38**
Amide nitrogen	......	......	.58	.03	1.63	.054	2.48	.08	1.82	.06	1.25	.04	**7.76**

JERSEY — GILDERBLOOM.

ARRIVED AT STATION, JULY 16, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	......	......	......	......	675.7	42.2	1134.4	36.6	1217.3	40.6	**3027.4**
Hay	......	......	......	......	......	......	45.8	2.9	106.6	3.4	70.6	2.4	**223.0**
Beets	......	......	......	......	......	......	......	......	......	......	......	......	... .
Alfalfa forage	......	......	......	......	......	......	169.9	20.0	304.6	29.0	......	......	**474.5**
Rye forage	......	......	......	......	......	......	......	......	......	......	......	......	....
Oat and pea forage	......	......	......	......	......	......	126.6	21.1	55.1	18.4	......	......	**181.7**
Maize forage	......	......	......	......	......	......	21.9	21.9	524.0	30.8	360.1	22.5	**906.0**
Hungarian grass	......	......	......	......	......	......	......	......	13.7	13.7	312.8	19.5	**326.5**
Wheat bran	......	......	......	......	......	......	......	......	......	......	......	......	....
Linseed meal	......	......	......	......	......	......	......	......	......	......	......	......	....
Mixed grains, No. 1	......	......	......	......	......	......	......	......	......	......	......	......	....
Mixed grains, No. 2	......	......	......	......	......	......	62.0	4.0	80.0	4.0	......	......	**142.0**
Mixed grains, No. 4	......	......	......	......	......	......	......	......	44.0	4.0	117.0	3.9	**161.0**
Increase in live weight and daily gain	......	......	......	......	......	......	......	......	42.0	1.35	35.0	1.17	**77.0**

JERSEY — GILDERBLOOM.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	......	......	......	......	675.7	42.2	1134.4	36.6	1217.3	40.6	**3027.4**
Water in food	......	......	......	......	......	......	249.9	15.6	775.1	25.0	545.2	18.2	**1570.2**
Dry matter eaten	......	......	......	......	......	......	176.3	11.0	352.9	11.3	315.3	10.5	**844.5**
Ash	......	......	......	......	......	......	12.25	.76	22.86	.73	17.02	.57	**52.13**
Albuminoids Nx 6.25	......	......	......	......	......	......	32.40	2.0	61.34	2.0	44.05	1.5	**137.79**
Crude fiber	......	......	......	......	......	......	41.70	2.9	85.50	2.8	71.47	2.4	**198.67**
Nitrogen-free extract	......	......	......	......	......	......	81.74	5.1	166.01	5.5	168.88	5.6	**416.63**
Fat	......	......	......	......	......	......	8.17	.5	17.15	.7	13.89	.46	**39.21**
Invert sugar	......	......	......	......	......	......	3.12	.20	8.42	.27	14.29	.47	**25.83**
Sucrose	......	......	......	......	......	......	4.81	.30	13.98	.45	8.17	.27	**26.96**
Starch	......	......	......	......	......	......	43.48	2.7	91.30	3.0	87.42	2.9	**222.20**
Albuminoid nitrogen	......	......	.....	......	......	......	3.83	.24	7.53	.24	5.47	.18	**16.83**
Amide nitrogen	......	......	......	......	......	......	1.30	.08	2.13	.07	1.35	.04	**4.78**

GENERAL AVERAGES.

We have given a brief summary of the results for each individual animal, and may now group them together, according to breed, and use the average for each set. We should bear in mind that, for the Holstein and Ayrshire, the average is that of four animals, and for the Guernseys and Holderness two each, while of Jersey but one is given.

The live weight given is the average live weight for all the animals in the breed, and the average monthly gain is the average calculated in the same manner. The dry matter eaten for one pound gain is calculated from the data given in the table.

The average weight of the animals, ranging between about 400 and 900 pounds, we can not well compare the results as they stand, and, in order to aid to a better understanding, I have calculated the amount of dry matter eaten per 1,000 pounds live weight, for the same ratio as eaten, that is the dry matter multiplied by 1,000 and divided by weight of animal gives results. This will be of interest as showing the changes in ratio as the animals come to maturity.

The column at the extreme right of the table, headed "Per 1,000 pounds live weight," is found by taking the average for the entire period, multiplying by 1,000 and dividing by the average weight of the animal for the entire period.

HOLSTEIN-FRIESIANS.

	April.	May.	June.	July.	August.	Sept.	Per 1,000 lbs. live weight.
Water drunk	965.4	1476.8	1670.3	2065.8	1624.4	1520.2	**2039.1**
Water in food	275.9	209.2	417.4	500.1	822.6	590.1	**615.7**
Dry matter eaten	347.8	385.2	374.1	412.0	463.00	351.5	**510.4**
Ash	17.01	20.62	23.87	28.05	26.12	19.08	**29.48**
Albuminoids Nx 6.25	52.32	59.76	63.77	75.46	74.29	49.24	**81.98**
Crude fiber	76.97	92.29	92.42	94.75	92.47	80.33	**115.75**
Nitrogen-free extract	213.37	196.94	178.54	195.52	199.60	187.56	**256.21**
Fat	12.90	15.02	15.68	18.50	19.84	15.54	**21.32**
Invert sugar	15.52	17.48	13.65	8.75	8.69	15.60	....
Sucrose	27.81	16.33	9.85	10.89	15.71	9.15	....
Starch	74.48	86.33	95.60	105.58	114.78	97.49	....
Live weight	642.0	717.0	762.0	785.0	817.0	882.0	....
Average monthly gain	53.0	75.0	45.0	23.0	32.0	65.0	....
Dry matter for each pound increase	6.5	5.1	8.3	17.9	14.4	5.4	....
Dry matter eaten per 1,000 lbs. live weight	541.7	537.2	490.9	524.8	566.7	398.5	....

AYRSHIRES.

	April.	May.	June.	July.	August.	Sept.	Per 1,000 lbs. live weight.
Water drunk	......	921.2	1246.2	1638.8	1180.5	1165.3	**2151.0**
Water in food	......	110.1	351.2	459.2	740.6	567.6	**779.2**
Dry matter eaten	......	241.2	324.4	374.0	363.4	330.4	**570.4**
Ash	......	13.84	20.20	25.34	12.27	15.40	**30.43**
Albuminoids	......	38.27	55.76	66.64	61.50	46.59	**93.97**
Crude fiber	......	63.12	81.0	87.38	81.10	74.64	**135.40**
Nitrogen-free extract	......	129.98	155.07	173.09	166.63	176.69	**280.23**
Fat	......	9.89	13.84	16.57	17.19	14.55	**25.19**
Invert sugar	......	12.04	12.43	8.50	7.85	13.95	....
Sucrose	......	8.96	8.39	9.59	13.67	8.59	....
Starch	......	68.27	81.30	88.33	91.44	92.73	....
Live weight	......	488.0	542.0	570.0	603.0	658.0	....
Average monthly gain	......	65.0	54.0	28.0	33.0	55.0	....
Dry matter for each pound increase	......	3.7	6.0	13.4	11.0	6.1	....
Dry matter eaten per 1,000 lbs. live weight	......	494.2	598.5	656.1	602.6	502.1	....

AMERICAN HOLDERNESS.

Water drunk	......	975.1	1186.0	1519.5	1211.7	1104.0	**2247.5**
Water in food	......	116.0	269.3	433.5	655.0	482.3	**798.4**
Dry matter eaten	......	238.0	269.6	295.2	296.9	235.1	**544.8**
Ash	......	12.52	16.80	21.22	19.21	15.32	**34.72**
Albuminoids Nx 6.25	......	42.89	46.74	58.25	53.95	41.37	**101.71**
Crude fiber	......	52.56	63.99	62.49	67.04	61.72	**125.63**
Nitrogen-free extract	......	121.88	131.02	135.56	141.94	154.18	**279.42**
Fat	......	9.69	11.27	12.83	14.28	12.51	**24.73**
Invert sugar	......	9.57	9.52	4.99	6.40	11.20	....
Sucrose	......	9.40	7.27	8.04	12.14	7.62	....
Starch	......	59.64	70.29	74.44	80.03	82.44	....
Live weight	......	422.0	457.0	483.0	517.0	571.0	....
Average monthly gain	......	70.0	35.0	27.0	34.0	54.0	....
Dry matter for each pound, increase	......	3.4	7.7	10.9	8.7	4.4	....
Dry matter eaten per 1,000 lbs. live weight	......	564.0	589.9	611.1	574.2	411.7	....

GUERNSEYS.

Water drunk	......	....	1405.1	1704.5	133.4	1290.4	**2730.0**
Water in food	......	....	366.2	464.3	635.6	541.3	**954.8**
Dry matter eaten	......	....	332.2	372.7	338.3	318.2	**648.1**
Ash	......	....	20.83	255.8	20.18	17.25	**39.92**
Albuminoids	......	....	56.37	67.62	54.77	44.84	**106.47**
Crude fiber	......	....	82.07	87.56	77.20	72.01	**151.82**
Nitrogen-free extract	......	....	159.09	175.27	170.46	170.04	**321.35**
Fat	......	....	13.96	16.71	15.72	14.01	**28.76**
Invert sugar	......	....	12.33	9.01	10.65	14.09	....
Sucrose	......	....	8.74	9.72	11.30	8.30	....
Starch	......	....	83.97	88.18	92.73	88.80	....
Live weight	......	421.0	474.0	506.0	540.0	585.0	....
Average monthly gain	......	....	53.0	31.0	34.0	44.0	....
Dry matter for each pound increase	......	....	6.2	12.0	9.9	7.2	....
Dry matter eaten per 1,000 lbs. live weight	......	....	700.8	736.5	626.5	578.3	....

JERSEYS.

	April.	May.	June.	July.	August.	Sept.	Per 1,000 lbs. live weight.
Water drunk	......	....	....	....	1134.4	1217.3	**2070.0**
Water in food	......	....	....	....	775.1	545.2	**1162.1**
Dry matter eaten	......	....	....	....	352.9	315.3	**588.2**
Ash	......	....	....	....	22.86	17.02	**35.1**
Albuminoids	......	....	....	....	61.34	44.05	**92.76**
Crude fiber	......	....	....	....	85.50	71.47	**138.22**
Nitrogen-free extract	......	....	....	....	166.01	168.88	**294.78**
Fat	......	....	....	....	17.15	13.89	**27.32**
Invert sugar	......	....	....	....	8.42	14.29	....
Sucrose	......	....	....	....	13.98	8.17	....
Starch	......	....	....	....	91.30	87.42	....
Live weight	......	....	....	509.0	551.0	586.0	....
Average monthly gain	......	....	....	....	42.0	35.0	....
Dry matter for each pound increase	......	....	....	....	8.4	9.0	....
Dry matter eaten per 1,000 lbs. live weight	......	....	....	....	640.4	538.0	....

In the table last presented there is one interesting point brought forcibly to notice in every case and that is the pounds of dry matter for one pound of gain for the several months. In June more dry matter was required than in May, and the largest amount in July, averaging more than three times as much for the month of July as for May, or as 4.1 to 14.1. In August less dry matter was required for one pound of gain than in July, while the month of September approximated the month of June. While feeders have recognized this fact, I believe these are the first trials to determine the real difference in favor of so arranging our system of feeding as to take advantage of the spring and autumn months for fattening animals. The continuation of this experiment through the winter and another summer will no doubt give much valuable data on the amount of food required to produce a pound of gain for the different seasons of the year as well as for the several stages of growth for the animal. The results will be tabulated in periods of six months each, and the summary given to the public at these dates.

FEEDING EXPERIMENT — STEERS.

The feeding of the steers of a few breeds has been conducted in a similar manner to that with the heifers, and in the following pages are given the additional data of general interest up to October 1, 1889.

The following table gives the names, breeds, age in days April first, and date of arrival at Station:

NAME.	Breed.	Age in days April 1, 1889.	Arrived at Station.	
Alexander Hamilton	Holstein-Friesian	62	April	2
D. B. Hill.....................	American Holderness........	222	April	10
Grover Cleveland............	American Holderness........	212	April	10
Cathay........................	Guernsey......................	37	May	9
Khaledan.....................	Guernsey.......	28	May	9

Fodders fed.

The description of hay and forage, as given for the heifers, applies equally to the following animals:

Grain mixtures Nos. 1, 2 and 4 were the same as fed heifers, previously described.

Grain mixture No. 3 was as follows:

Corn meal, 200 pounds; wheat bran, 200 pounds; linseed meal, 240 pounds; wheat middlings, 200 pounds; oats, crushed, 100 pounds.

This mixture was fed from June fifteen to August twenty, after which No. 4 was fed.

The skim milk was a mixture from Station milk and that purchased of a neighboring milkman, and the average of analyses for skim milks were used in calculating results.

Gruel.

The gruel fed previously to July twenty-third was made by adding one ounce of old-process linseed meal to one pound of water and bring it to a boil. After July twenty-three two ounces of linseed meal to one pound of water were used, otherwise the same.

The two animals, Cathay and Khaledan, were in bad condition when received at the Station, and several months were required to get them well started, yet fair gain in growth was steadily maintained by constant watchfulness and care in feeding.

No discussion of results are necessary until more data is accumulated from longer continuation of the experiment.

HOLSTEIN–FRIESIAN — ALEXANDER HAMILTON.

ARRIVED AT STATION, APRIL 2, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	18.3	......	0	......	54.0	9.0	359.0	11.6	643.0	20.7	960.0	32.0	**2034.3**
Hay	81.8	3.3	96.5	3.1	61.9	2.1	59.1	1.9	38.7	1.2	30.9	1.0	**368.9**
Beets	......	......	18.3	1.8	......	......	......	......	......	......	......	......	**18.3**
Alfalfa forage	......	......	48.4	2.3	80.6	6.4	188.9	9.4	197.8	18.8	......	......	**515.7**
Rye forage	......	......	......	......	97.3	5.6	21.2	5.3	......	......	......	......	**118.5**
Oat and pea forage	......	......	......	......	......	......	70.9	13.3	32.4	10.8	......	......	**112.3**
Maize forage	......	......	......	......	......	......	13.9	13.9	351.3	20.7	245.4	15.3	**610.6**
Hungarian grass	......	......	......	......	......	......	......	......	8.8	8.8	227.7	16.3	**236.5**
Milk skimmed	421.0	14.5	428.0	13.8	360.0	12.0	314.0	10.1	186.0	6.0	......	......	**1709.0**
Gruel	224.0	8.3	323.5	10.4	359.0	12.0	368.0	11.9	372.0	12.0	360.0	12.0	**2006.5**
Wheat bran	.8	......	6.3	.5	......	......	......	......	......	......	......	......	**7.1**
Linseed meal	......	......	6.3	.5	......	......	......	......	......	......	......	......	**6.3**
Oat meal	......	......	5.0	.5	......	......	......	......	......	......	......	......	**5.0**
Mixed grains, No. 1	......	......	32.7	1.9	26.1	1.9	......	......	......	......	......	......	**58.8**
Mixed grains, No. 3	......	......	......	......	33.1	2.1	91.8	3.0	83.3	4.2	......	......	**208.2**
Mixed grains, No. 4	......	......	......	......	......	......	......	......	54.5	5.0	150.0	5.0	**204.5**
Increase in live weight and daily gain	......	......	69.0	2.22	66.0	2.20	54.0	1.74	65.0	2.09	67.0	2.23	....

HOLSTEIN–FRIESIAN — ALEXANDER HAMILTON.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total.	Daily average.	Total.	Daily average.	Total.	Daily average.	Total.	Daily average.	Total.	Daily average.	Total.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk*	229.10	7.90	304.5	9.8	391.90	13.0	340.7	10.90	987.5	31.80	1277.60	42.80	**3531.3**
Water in food	389.40	12.90	455.1	14.3	150.70	5.0	528.6	17.0	678.60	21.90	390.20	13.0	**2592.6**
Dry matter eaten	127.10	4.20	205.4	6.6	169.40	5.60	267.50	8.60	301.70	9.70	306.60	10.20	**1377.6**
Ash	7.33	.24	12.06	.4	9.97	.33	16 59	.54	17.87	.57	16.39	.54	**80.21**
Albuminoids Nx 6.25	29.94	.99	46.80	1.5	31.23	1.0	60.0	1.90	64.19	2.10	55.98	1.80	**288.14**
Crude fiber	24.86	.82	37.55	1.2	38.44	1.2	46.83	1.50	53.06	1.70	55.31	1.80	**256.05**
Nitrogen-free extract	59.94	1.90	100.31	3.2	82.23	2.70	131.51	4.20	151.77	5.0	164.32	5.50	**690.08**
Fat	5.11	.17	8.68	.28	7.53	.25	12.58	.40	14.80	.49	14.57	.48	**63.27**
Glucose	26.01	.87	27.83	.9	6.05	.20	20.16	.67	14.12	.49	9.68	.32	**103.85**
Sucrose	1.86	.06	5.02	.16	3.86	.13	4.9	.16	9.81	.32	8.12	.27	**33.57**
Starch	13.83	.46	37.41	1.2	44.84	1.50	69.42	2.30	91.15	3.0	93.57	3.10	**350.22**
Abuminoid N	4.59	.15	6.83	.22	4.08	.13	7.90	.26	8.41	.28	7.39	.24	**39.2**
Amide N	.23	.008	.63	.02	.90	.03	1.51	.05	1.55	.05	1.26	.04	**6.08**
Live weight	233.0	......	302.0	......	368.0	......	422.0	......	488.0	......	561.0	......	....
Dry matter for each pound gain	......	......	2.9	......	2.60	......	4.9	......	4.6	......	4.6	......	....
Dry matter eaten per 1,000 lbs. live weight	......	......	680.1	......	460.3	......	633.9	......	618.2	......	546.5	......	....

*Includes water in gruel.

AMERICAN HOLDERNESS — D. B. HILL.

ARRIVED AT STATION, APRIL 10, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	0	0	983.9	36.4	1547.2	51.6	2034.0	65.6	1569.9	50.6	1359.3	45.3	**7494.3**
Hay	58.5	2.8	135.5	4.4	106.5	3.5	105.3	3.4	78.9	2.5	55.1	1.8	**544.8**
Beets	......	......	50.0	5.0	......	......	......	......	......	......	......	......	**50.0**
Alfalfa forage	......	......	57.7	2.7	154.8	12.4	362.2	18.1	277.6	26.4	......	......	**852.3**
Rye forage	......	......	......	......	161.3	9.2	44.4	11.1	......	......	......	......	**205.7**
Oat and pea forage	......	......	......	......	......	......	105.0	17.5	49.1	16.4	......	......	**154.1**
Maize forage	......	......	......	......	......	......	19.6	19.6	493.8	29.0	305.0	19.1	**818.4**
Hungarian grass	......	......	......	......	.....	......	......	......	12.0	12.0	313.0	22.4	**325.0**
Milk, skimmed	293.3	14.0	62.0	10.3	......	......	......	......	......	......	......	......	**355.3**
Gruel	171.0	8.1	54.0	9.0	......	......	......	......	......	......	......	......	**225.0**
Wheat bran	20.4	1.0	13.6	1.0	......	......	......	......	......	......	......	......	**34.0**
Linseed meal	10.5	.5	10.8	.8	......	......	......	......	......	......	......	......	**21.3**
Oat meal	20.4	1.0	12.5	1.0	......	......	......	......	......	......	......	......	**32.9**
Mixed grain, No. 1	......	......	84.2	5.0	71.5	5.1	......	......	......	......	......	......	**155.7**
Mixed grain, No. 3	......	......	......	......	95.0	5.9	186.0	6.0	144.8	7.2	......	......	**425.8**
Mixed grain, No. 4	......	......	......	......	......	......	......	......	92.9	8.4	262.5	8.8	**355.4**
Increase in live weight and daily gain	......	......	67.0	2.13	57.0	1.90	43.0	1.35	49.0	1.58	57.0	1.90	....

AMERICAN HOLDERNESS — D. B. HILL.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs,	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	160.0	7.50	1034.7	34.0	1547.2	51.6	2034.0	65.60	1569.90	50.60	1359.3	45.30	**7705.1**
Water in food	277.1	13.80	173.0	5.6	270.2	9.0	433.60	14.00	728.20	23.50	505.8	16.80	**2387.9**
Dry matter eaten	137.5	6.80	256.5	8.3	318.9	10.6	388.90	12.50	429.90	13.90	369.5	12.30	**1901.2**
Ash	7.07	.35	13.90	.45	18.08	.60	23.43	.76	23.80	.77	19.49	.65	**105.77**
Albuminoids Nx 6.25	30.93	1.50	43.62	1.4	54.80	1.49	69.32	2.20	75.56	2.40	57.05	1.90	**331.3**
Crude fiber	21.62	1.00	55.14	1.8	68.38	2.3	78.95	2.50	81.23	2.60	73.08	2.40	**378.4**
Nitrogen-free extract	71.67	3.60	133.82	4.4	164.32	5.5	200.00	6.50	220.56	7.10	203.55	6.80	**993.92**
Fat	5.92	.29	10.31	.34	13.35	.44	17.25	.56	19.84	.65	16.32	.54	**82.99**
Glucose	18.54	.90	12.83	.41	10.61	.35	8.47	.27	8.14	.26	13.16	.44	**71.75**
Sucrose	2.31	.11	10.06	.33	7.81	.26	7.14	.23	14.63	.48	10.92	.36	**52.87**
Starch	31.84	1.60	63.01	2.1	96.19	3.2	123.06	4.0	142.83	4.6	115.78	3.80	**572.71**
Albuminoids N	4.71	.23	6.01	.20	6.93	.23	8.36	.27	9.48	.30	7.18	.24	**42.67**
Amide N	.29	.01	.95	.03	1.66	.05	2.65	.09	2.26	.07	1.50	.05	**9.31**
Live weight	436.0	......	503.0	......	560.0	......	603.0	......	651.0	......	719.0	......	....
Dry matter for each pound gain	......	......	3.8	......	5.6	......	9.0	......	8.8	......	6.5	......	....
Dry matter eaten, per 1,000 pounds live weight	......	......	509.9	......	567.1	......	644.9	......	660.3	......	513.9	......	....

AMERICAN HOLDERNESS — GROVER CLEVELAND.

ARRIVED AT STATION, APRIL 10, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	7.5	......	795.3	31.8	1127.0	37.6	1551.2	50.0	1133.2	36.9	1252.9	41.8	**5867.1**
Hay	56.4	2.7	135.7	4.4	101.9	3.4	88.4	2.9	69.6	2.2	47.1	1.6	**499.1**
Beets	......	......	48.5	4.8	......	......	......	......	......	......	......	......	**48.5**
Alfalfa forage	.....	......	57.0	2.7	152.7	12.2	360.2	18.0	265.0	25.2	......	......	**834.9**
Rye forage	......	......	......	......	83.7	4.8	19.7	4.2	......	......	......	......	**103.4**
Oat and pea forage	......	......	......	......	......	......	88.2	14.7	43.4	14.5	......	......	**131.6**
Maize forage	......	......	......	......	......	......	17.3	17.3	486.2	28.6	301.5	18.8	**805.0**
Hungarian grass	......	.....	......	......	......	......	......	......	11.9	11.9	289.8	20.7	**301.7**
Milk, skimmed	309.8	14.8	62.0	10.3	......	......	......	......	......	......	......	......	**371.8**
Gruel	184.5	8.8	54.0	9.0	......	......	......	......	......	......	......	......	**238.5**
Wheat bran	20.5	1.0	15.1	1.1	......	......	......	......	......	......	......	......	**35.6**
Linseed meal	10.6	0.5	10.8	0.8	......	......	......	......	......	......	......	......	**21.4**
Oat meal	20.5	1.0	12.8	1.0	......	......	......	......	......	......	......	......	**33.3**
Mixed grains, No. 1	......	......	85.0	5.0	71.5	5.1	......	......	......	......	......	......	**156.5**
Mixed grains, No. 3	......	......	......	......	95.0	5.9	186.0	6.0	144.8	7.2	......	......	**425.8**
Mixed grains, No. 4	......	......	......	......	......	......	......	......	99.0	9.0	262.5	8.8	**361.5**
Increase in live weight and daily gain	......	......	64.0	2.07	23.0	0.76	51.0	1.61	53.0	1.71	63.0	2.13	....

AMERICAN HOLDERNESS — GROVER CLEVELAND.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	181.10	8.6	846.10	27.30	1127.00	37.60	1551.2	50.00	1133.20	36.90	1252.90	41.80	**6091.5**
Water in food	291.60	14.5	171.60	5.50	209.2	7.00	396.2	13.00	706.80	22.80	441.60	14.70	**2217.0**
Dry matter eaten	137.10	6.8	258.50	8.3	295.6	9.80	363.6	12.00	413.10	13.30	409.30	13.60	**1877.2**
Ash	7.17	3.6	13.99	.45	16.51	.55	22.15	.70	23.20	7.50	21.21	.70	**104.23**
Albuminoids Nx 6.25	31.32	1.5	44.03	1.40	51.75	1.70	65.95	2.10	74.44	2.40	66.16	2.20	**333.65**
Crude fiber	21.00	1.0	55.09	1.80	59.92	2.00	70.33	2.20	77.54	2.50	74.32	2.50	**358.2**
Nitrogen-free extract	71.57	3.6	135.07	4.50	155.16	5.10	189.19	6.10	218.23	7.00	229.54	7.60	**998.76**
Fat	5.90	.29	10.40	.34	12.26	.40	15.96	.52	19.45	.64	18.10	.60	**82.07**
Glucose	19.20	.96	12.88	.41	9.35	.31	7.51	.24	7.72	.25	12.73	.42	**69.39**
Sucrose	2.26	.11	10.04	.33	7.51	.25	7.65	.25	14.28	.43	11.46	.35	**53.2**
Starch	32.40	1.60	65.62	2.10	92.47	3.10	118.46	3.80	140.51	4.60	135.95	4.80	**585.41**
Albuminoid N	4.78	.23	6.04	.20	6.60	.22	7.80	.25	9.28	.30	8.36	.28	**42.86**
Amide N	.29	.01	.96	.03	1.49	.05	2.43	.08	2.17	.07	1.61	.05	**8.95**
Live weight	485.0	......	5.49	......	5.72	......	623.0	......	676.0	......	744.0	......	....
Dry matter for each pound gain	......	......	4.0	......	12.8	......	7.1	......	7.8	......	6.5	......	....
Dry matter eaten, per 1,000 pounds live weight.	......	......	489.0	......	515.1	......	583.6	......	611.1	......	538.0	......	....

GUERNSEY — CATHAY.

ARRIVED AT STATION, MAY 9, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	0	0	17.0	4.2	63.2	2.0	44.3	1.4	123.2	4.1	**247.7**
Hay	......	......	13.5	.6	10.0	.3	11.4	.4	21.1	.7	19.4	.6	**75.4**
Beets	......	......	......	......	......	......	......	......	......	......	......	......	....
Alfalfa forage	......	.....	9.0	1.0	30.2	2.4	89.2	4.5	74.6	7.1	......	......	**203.0**
Rye forage	......	......	......	......	25.5	1.5	4.5	1.1	......	......	......	......	**30.0**
Oat and pea forage	......	......	......	......	......	......	31.9	5.3	14.9	5.0	......	......	**46.8**
Maize forage	......	......	......	......	......	......	4.4	4.4	110.0	6.5	139.6	8.7	**254.0**
Hungarian grass	......	......	......	......	......	......	......	......	4.0	4.0	118.2	8.4	**122.2**
Milk, skimmed	......	......	270.0	11.7	360.0	12.0	372.0	12.0	372.0	12.0	302.0	10.1	**1676.0**
Gruel	......	......	121.0	7.1	339.0	11.3	372.0	12.0	372.0	12.0	360.0	12.0	**1564.0**
Wheat bran	......	......	2.8	.5	......	......	......	......	......	......	......	......	**2.8**
Linseed meal	......	......	......	......	......	......	......	......	......	......	......	......	....
Oat meal	......	......	......	......	......	......	......	......	......	......	......	......	....
Mixed grains, No. 1	......	......	16.3	1.0	13.7	1.0	......	......	......	......	......	......	**30.0**
Mixed grains, No. 3	......	......	......	......	16.0	1.0	31.0	1.0	37.4	1.9	......	......	**84.4**
Mixed grains, No. 4	......	......	......	......	......	......	......	......	32.1	2.9	90.0	3.0	**122.1**
Increase in live weight and daily gain	......	......	......	......	40.0	1.33	38.0	1.22	44.0	1.42	49.0	1.60	....

GUERNSEY — CATHAY.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	113.90	4.9	336.1	11.20	344.59	11.10	388.80	12.50	440.8	14.70	**1624.1**
Water in food	......	......	253.10	11.5	370.0	12.30	436.40	14.10	512.60	16.50	486.3	16.20	**2058.4**
Dry matter eaten	......	......	68.40	3.00	105.1	3.50	135.50	4.40	181.00	5.90	225.3	7.50	**715.3**
Ash	......	......	4.17	.20	6.64	.22	8.91	.29	10.80	.35	12.64	.42	**43.16**
Albuminoids Nx 6.25	......	......	20.32	1.00	31.94	1.00	39.26	1.30	46.96	1.50	52.01	1.70	**190.49**
Crude fiber	......	......	6.94	.30	11.24	.34	17.02	.56	24.30	.79	33.02	1.10	**92.52**
Nitrogen-free extract	......	......	34.11	1.50	50.34	1.70	63.67	2.10	89.92	2.90	116.64	3.90	**354.68**
Fat	......	......	3.16	.14	5.05	.17	6.64	.21	8.96	.30	10.97	.39	**34.78**
Glucose	......	......	14.16	.7	18.78	.62	19.47	.63	20.24	.65	20.12	.67	**92.77**
Sucrose	......	......	.84	.4	1.56	.05	2.01	.07	4.28	.14	4.97	.16	**13.66**
Starch	......	......	12.55	.6	21.00	.7	26.44	.85	45.20	1.50	58.36	1.60	**163.55**
Albuminoid N	......	......	3.08	.14	4.72	.16	5.54	.18	6.66	.21	7.39	.24	**27.39**
Amide N	......	......	.17	.01	.36	.01	.67	.02	.72	.02	.78	.03	**2.7**
Live weight	......	......	180.0	......	220.0	......	258.0	......	302.0	......	351.0	......	....
Dry matter for each pound gain	......	......	......	......	2.6	......	3.6	......	4.1	......	4.6	......	....
Dry matter eaten, per 1,000 pounds live weight	......	......	......	......	477.7	......	525.1	......	599.3	......	641.8	......	....

GUERNSEYS — KHALEDAN.

ARRIVED AT STATION, MAY 9, 1889.	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	.0	.0	17.0	4.2	146.0	4.7	82.4	2.7	209.5	7.0	454.9
Hay	......	......	33.0	1.5	25.2	0.8	21.1	0.7	27.5	0.9	26.7	0.9	133.5
Beets	......	......	......	......	......	......	......	......	......	......	......	......	....
Alfalfa forage	......	......	9.0	1.0	39.4	3.2	111.5	5.6	96.8	9.2	......	......	256.7
Rye forage	......	......	......	......	34.5	2.0	5.4	1.3	......	......	......	......	39.9
Oat and pea forage	......	......	......	......	......	......	34.4	5.7	19.8	6.6	......	......	54.2
Maize forage	......	......	......	......	......	......	5.6	5.6	184.4	10.8	172.0	10.7	362.0
Hungarian grass	......	......	......	......	......	......	......	......	3.1	3.1	120.9	8.6	124.0
Milk, skimmed	......	......	268.0	11.7	360.0	12.0	368.0	11.9	372.0	12.0	297.8	9.9	1665.8
Gruel	......	......	121.0	7.1	339.0	11.3	368.0	11.9	372.0	12.0	355.5	11.9	1555.5
Wheat bran	......	......	2.8	0.5	......	......	......	......	......	......	......	......	2.8
Linseed meal	......	......	......	......	......	......	......	......	......	......	......	......	....
Oat meal	......	......	......	......	......	......	......	......	......	......	......	......	....
Mixed grains, No. 1	......	......	16.9	1.0	14.0	1.0	......	......	......	......	......	......	30.9
Mixed grains, No. 3	......	......	......	......	16.0	1.0	32.0	1.0	38.6	1.9	......	......	86.6
Mixed grains, No. 4	......	......	......	......	......	......	......	......	32.5	3.0	90.0	3.0	122.5
Increase in live weight and daily gain	......	......	......	......	42.0	1.40	48.0	1.51	52.0	1.69	68.0	2.27	....

GUERNSEY — KHALEDAN.

	APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		Total to date.
	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	Total eaten.	Daily average.	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water drunk	......	......	113.9	4.90	336.10	112.0	340.7	10.9	426.9	13.8	523.2	17.8	**1740.8**
Water in food	......	......	2542	11.50	386.0	12.90	455.0	14.7	599.8	19.3	512.6	17.1	**2207.6**
Dry matter eaten	......	......	85.4	4.00	123.0	4.10	150.3	4.5	202.4	6.50	236.6	7.9	**797.7**
Ash	......	......	4.99	.22	7.67	.25	9.99	.32	12.29	.40	13.21	.44	**48.15**
Albuminoids Nx 6.25	......	......	21.81	1.0	34.01	1.10	41.33	1.3	50.37	1.60	52.84	1.7	**200.36**
Crude fiber	......	......	12.64	.60	17.10	.57	21.58	.7	30.57	1.0	36.50	1.2	**118.39**
Nitrogen-free extract	......	......	42.28	1.90	58.53	1.90	70.14	2.3	99.10	3.20	122.60	4.1	**392.65**
Fat	......	......	3.65	.17	5.69	.19	7.31	.24	10.06	.32	11.46	.38	**38.17**
Glucose	......	......	15.39	.70	19.98	.66	19.86	.65	20.95	.65	20.81	.69	**96.99**
Sucrose	......	......	1.59	.07	1.95	.06	2.31	.07	5.45	.18	5.07	.17	**16.37**
Starch	......	......	15.28	.70	23.95	.80	29.60	.96	50.39	1.60	60.61	2.0	**179.83**
Albuminoids N	......	......	3.30	.15	4.95	.16	5.79	.19	6.34	.20	6.43	.21	**27.81**
Amide N	......	......	.21	.01	.44	.01	.79	.02	.88	.03	.84	.03	**3.16**
Live weight	......	......	182.0	......	232.0	......	280.0	......	332.0	......	400.0	......	....
Dry matter for each pound gain	......	......	......	......	2.9	......	3.1	......	3.8	......	3.5	......	....
Dry matter eaten, per 1,000 pounds live weight	......	......	......	......	530.1	......	536.8	......	606.0	......	591.5	......	....

RELATIVE FEEDING VALUE OF SOME GRAIN RATIONS.

FEEDING EXPERIMENTS WITH COW NELLIE.

For a feeding experiment during the winter of 1888–9, the Jersey cow Nellie, 6 years old, was selected for the purpose. The cow was fresh in milk, having dropped her calf November twenty-six. The feeding begun December eleven and continued until February twenty-two, the time being divided into four periods as follows:

	Days.
Period I	12
Period II	21
Period III	20
Period IV	20

We take the averages for the last ten days of each period so as to eliminate the influence due to the changes in food. Linseed meal was not relished by the cow, and the amount eaten per day was variable.

The milk yield gradually fell off during the corn meal period, but the substitution of an equal weight of gluten meal for corn meal caused an increased flow of milk, which was well maintained through the period. The substitution of crushed oats for gluten meal failed to maintain the quality of milk during the third period, and in the fourth period the linseed meal, poorly eaten, maintained nearly the same yield as the oats for the whole period, but for the

Averages for the last ten days of each period—cow Nellie.

PERIOD.	Average weight of animal.	Average water drank.	AVERAGE FOOD EATEN PER DAY.							Milk per day.	Cost of ration per day.
			Hay.	Ensilage.	Corn meal.	Wheat bran.	Gluten meal.	Crushed oats.	Linseed meal.		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.
I	1028	59.3	14.0	15.8	6	2	....	....	....	19.6	17.4
II	1045	69.5	14.9	19.8	....	2	6	....	....	20.7	19.4
III	1054	62.0	15.2	19.0	....	2	...	6	....	17.5	19.9
IV	1049	63.9	15.3	19.4	....	3.1	....	....	5.5	17.3	20.9

last four days the falling off was greater since very little meal was taken when it was attempted to adjust the ration to correspond with the other periods.

The milk was carefully analyzed for the last four days of each period, giving eight analyses for each period. The number of analyses should have been twice this to be fully satisfactory. It is interesting to note that while the milk yield under gluten meal for three days averaged 26.7 ounces more per day than for the previous period with corn meal, yet there was a loss of 1.48 ounces of fat per day. This confirms what has been indicated before, that gluten meal increases the flow of milk without proportionately increasing the solids or the fat, which, in butter-making, is the object sought. With crushed oats the milk fell off per day 55.3 ounces, while the fat fell but .72 ounces, and the quality of the butter was much better than that made under gluten meal feed. Linseed meal failed to give so good results as in previous trials, although there was a slight increase in fat and a falling off in yield of milk. A part of this effect may be attributed undoubtedly to the small amount eaten.

The milk was submerged for creaming as quickly as possible after being milked, and for convenience the skimmings made each morning.

Average composition of milk for the last four days of each period of feeding — cow Nellie.

Period.	FEED PER DAY.	Milk per day.	Water.	Solids.	Fat.	Caseine.	Sugar.	Ash.	Fat per day.
		Ounces.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Ounces.
1	Hay ad libitum Corn meal, six pounds Wheat bran, two pounds	308.3	84.35	15.65	6.09	3.47	5.42	.65	19.20
2	Hay ad libitum Gluten meal, six pounds Wheat bran, two pounds	335.0	84.68	15.32	5.56	3.92	5.06	.75	17.72
3	Hay ad libitum Crushed oats, six pounds Wheat bran, two pounds	279.7	84.03	15.97	6.21	3.99	5.01	.76	17.0
4	Hay ad libitum Linseed meal, 3.9 pounds Wheat bran, 2.7 pounds	268.7	84.83	15.17	6.51	4.27	4.93	.70	17.10

DATE.	Period.	Milk set.		Cream recovered.		Cream churned.		Temperature churned.	Time churned.	Butter.		Milk for one pound butter.		Cream for one pound butter.	Pounds butter for 100 pounds milk.	Per cent fat in butter.
		Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Deg.	Min.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.		
December 10-13	I.	65	¾	14	12½	13	5¼	59	8	4	8	14	7	3.29	6.92	....
December 14-19		114	4	22	3½	21	9¼	60	......	9	4½	12	3	2.33	8.21	....
December 20-22		56	2¾	11	8	11	2¼	59½	40	3	11	15	2	3.02	6.54	86.69
December 23-25	II.	56	2½	10	11¾	10	8¾	58	45	3	8¼	15	9	3.00	6.23	....
December 30-January 2		80	15½	15	7¼	15	¼	62	10	5	4½	15	3	2.74	6.50	....
January 3- 7		102	15¾	20	5	19	9¾	61	12	6	1¾	15	5	2.86	5.93	....
January 10-12		59	13½	11	9¾	11	5½	61	18	3	9¼	16	8	3.16	5.98	85.49
January 13-15	III.	60	4½	12	9	12	4½	61	12	4	½	14	9	3.04	6.68	....
January 16-18		58	11¾	11	6½	11	3¾	62	7	3	6	17	4	3.22	5.75	....
January 19-23		88	5¼	17	14¾	17	8½	63	35	5	14¾	14	9	3.03	6.66	....

DATE.	Period.	Milk set.		Cream from milk.		Creamed churned.		Temperature churned.	Time churning.	Butter.		Milk to one pound butter.		Cream to one pound butter.	Pounds butter to 100 pounds milk.	Per cent fat in butter.
		Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Deg.	Min.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.		
January 24-28	III.	86	8	17	11½	16	10½	63	30	5	10¼	15	3	2.95	6.53	....
January 29-February 1		67	14	14	6½	13	5	64	50	4	....	16	9	3.33	5.89	90.25
February 2- 7	IV.	102	2¼	20	11¾	20	1¾	64	30	6	9¾	15	3	3.04	6.47	....
February 8-13		103	2¼	21	8	20	14¼	64½	15	6	13¼	15	10	3.06	6.62	....
February 14-17		68	1¼	14	14¾	14	9¾	64½	10	4	13½	14	5	3.01	7.11	....
February 18-21		67	4	14	3	13	11½	65	8	4	11¾	14	2	2.89	7.03	....
February 22-26	V.	81	2	18	5½	17	12	65	12	5	4½	15	3	3.36	6.51	....
February 27-March 4		99	2½	20	3¼	19	11	65	18	6	8	15	2	3.02	6.55	....

The amount of milk required to produce a pound of butter in the several periods was approximately the same. The amount of cream required varied somewhat for the periods. It is interesting to note that with an individual cow the variation in the amount of cream required for one pound of butter was very marked, ranging from 2.33 pounds to 3.36 pounds. Ripening the cream and churning was always as nearly the same as could be secured in the Station dairy. The amount of cream for one pound of butter for this cow is considerably less than the average of the herd. Another point observed, that it was necessary to raise the temperature for churning with each change of grain as the period of lactation advanced. In the first period the churning being made at a temperature of 58° to 60° Fahr. while in the last period for the same results the cream was churned at 64° to 65° Fahr.

While the actual costs of the rations as fed are given, yet these have little significance as compared with the relative feeding value of the several foods. From the trials made with this animal, it is evident that gluten meal was a superior food for milk production.

A digestion experiment at the close of the fourth period prevented repeating the first period with corn meal to determine how much change had taken place due to advance in lactation. Work with the digestion experiment, and absence from the Station, prevented a further study of the butters for which purpose the experiment was more specially designed.

FEEDING EXPERIMENTS WITH COW FLORA.

A feeding trial, similar to that with Nellie, was carried on with the Jersey cow Flora, but we were at the time unable to make the necessary analyses and so only as to the effect on the milk yield can we compare the foods tested. Flora dropped her last calf December seventeenth and was removed to the experimental barn December twenty-sixth at which date the feeding trial began, and continued until February twenty-second, when a change in the rations was made to determine the digestibility of alfalfa hay.

The time was divided into four periods of like feeding as follows:

	Days.
Period I	10
Period II	14
Period III	15
Period IV	20

Taking only the last ten days of each period we have indications that with the cow under experiment that 3.8 pounds linseed meal and 3.5 pounds wheat bran are just about equivalent to eight pounds corn meal for maintaining the milk yield, but we find that 5.1 pounds less milk was required for one pound of butter. In period three, under palm-nut meal, there was a falling off in milk of 2.6 pounds per day. Under dry feed (starch waste) this decrease in milk was arrested, and the yield steadily increased to the close, indicating, † as has been previously shown at this Station, the value of this dried by-product from the starch and glucose manufactories for milk production.

PERIOD.	Weight of cow.	Water drank.	FOOD EATEN PER DAY.							Milk per day.	Cost of ration per day.
			Hay.	Ensilage.	Corn meal.	Wheat bran.	Linseed meal.	Palm nut meal.	Dry feed, No. 1.		
											Cents.
I.	938	71.7	15.3	19.9	8.0	2.0	....	....	....	20.7	20.0
II.	930	70.3	15.7	20.0	....	3.3	4.7	....	....	20.5	18.8
III.	958	59.7	15.3	20.0	....	3.6	....	3.6	....	17.4	15.1
IV.	967	56.1	15.5	20.0	....	2.1	....	....	7.0	18.1	19.8
V.	971	71.9	*24.4	....	....	....	....	....	....	15.0	14.6
VI.	985	89.2	*23.3	....	6.0	4.0	....	....	....	15.3	24.0

The yield of milk per day, period two, under linseed meal feed, was almost the same as in period one, but 5.1 pounds less milk were required for a pound of butter.

The per cent of fat in the two butters was very nearly the same, 85.27 per cent and 85.79 per cent. Whether the recovery of fat from the milk and cream was equally good for the two periods we cannot say, for unfortunately no analyses of milk were made at this time. The treatment of the milk and cream was always the same, but this trial can only be taken as indicating what has been found in other trials heretofore, that linseed meal gives more butter than corn meal. Immediately following the trials already considered there were two periods, the first with alfalfa hay and the second with alfalfa, corn meal and wheat bran. With the change in feed the milk yield fell 3.1 pounds per day, and the addition of grain feed did little more than check the decrease at a considerable additional expense per day.

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* The hay fed in this period was fine quality of alfalfa.

†Fourth Annual Report, page 23.

DATE.	Period.	Milk set.		Cream from milk.		Cream churned.		Temperature churned.	Time churning.	Butter.		Milk to one pound butter.		Cream to one pound butter.	Pounds butter to 100 pounds milk.	Per cent fat in butter.
		Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Deg.	Min.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.		
December 26-29.........	I.	83	12	14	5	14		65	57	4	6	19	1	3.20	5.21	....
December 30-January 2		81	12	13	3	13		63	70	3	13	21	5	3.38	4.74	85.27
January 16-18.............	II.	60	3	12		11	10	63	13	3	7	16	1	3.34	5.78	85.79
January 27-29...........	III.	49	10	10	14	10	6	63	8	3	3	15		3.22	6.48	....
January 30-February 2.		69	11	15		14	8	62½	60	4	5	15	11	3.35	6.37	80.16
February 12-17..........	IV.	108	11	22	12	22	4	64	15	7	1	13	14	3.15	6.49	....
February 18-22..........		85	5	17	12	16	14	65	12	5	10	15	1	3.0	6.59	....
February 23-26..........	V.	64	6	12	10	12	3	63	10	3	13	16	11	3.17	5.97	....
February 27-March 4...		84	4	16	2	15	14	64	10	4	11	17	14	3.35	5.62	....

DAIRY NOTES.

During the past year a few preliminary experiments have been undertaken in the dairy, and under the above head of "Dairy Notes" I give such results as have thus far been secured, as work of progress, rather than any completed experiments. All experiments of this kind must be repeated a large number of times and under all probable conditions before any fact can be established

SWEET VS. RIPENED CREAM.

It is frequently asserted that unless cream be properly ripened to slight acidity, there is in churning, a large loss of butter-fat, which is carried off in the buttermilk. Contrary to this we find some of our most successful and practical dairymen advocating the making of sweet-cream butter, and the demand on the part of consumers is steadily increasing for butter made from sweet cream. Test trials churning two lots of cream, the one sweet and the other ripened, convinced us that under ordinary methods of management there might be a loss of fifteen to twenty per cent in churning sweet cream. We at once instituted a series of experiments to find whether by more skillful management this loss could be prevented.

It has often been recommended to churn sweet cream at a higher temperature than would be required for cream properly ripened to slight acidity. At the time of the experiment the ripened cream was being churned at 62° Fahr. We then began dividing each day's cream, churning one-half sweet and allowing the remaining portion to ripen before being churned. The buttermilk from each churning was sampled and taken to the laboratory for analysis. In the buttermilk from the ripened cream there was found from 0.10 to 0.50 per cent of fat, according to management and skill in handling the milk and its products through the several stages. As the average per cent of fat in buttermilk is given at one per cent, we feel safe in claiming good recovery of fat in the case of ripened cream.

The trials at churning sweet cream were all made under the same conditions excepting the lowering of temperature for each series, and below are given a few of the results:

Temperature churned	68°	63°	60°	58½°	54½°	50°
Time churned	8′	24′	18′	13′	20′	25′
Solids in buttermilk	13.19	10.20	8.90	8.24	8.07	8.61
Fat in buttermilk	4.07	1.37	.57	.63	.23	.29

From an inspection of the preceding table we find that by churning sweet cream at the same or a higher temperature than is required for ripened cream there was a large loss of butter fat, in one case amounting to a little more than one-fifth of the total butter present in the cream, but by lowering the temperature to 50° to 54° Fahr. there was no greater loss than with the same cream ripened.

The quality of the butter, both in grain and color, steadily improved as the temperature for churning was lowered, and at 50° and 54° Fahr., was as good in appearance as that from well ripened cream. The flavor of butter from sweet cream is quite different from butter made from ripened cream. In every case there was found less casein in the butter from sweet cream than in that from ripened cream.

As a result of these experiments then we may say that under proper management there seems to be no greater loss of butter fat in churning sweet cream than with the best ripened cream.

Since the above experiments were completed there is shown another confirmation of the general results, in work previously done and published in the Annual Report of the New Hampshire Experiment Station.

TEMPERATURE FOR CHURNING.

The temperature for churning in order to secure the best results, is influenced by so many causes that it would be impossible to decide upon any fixed temperature to be used under all conditions. Generally in summer 58° to 60° Fahr., and in winter 60° to 64° Fahr., will be found a proper temperature. This does not hold true for all cases; for instance the cream from the milk of two cows during the feeding experiment for the winter of 1887–8, it was found necessary to churn at 53° to 56° Fahr. in order to secure the butter in good condition. At this temperature the butter was churned in the granular state in from twenty to thirty minutes. The cream from the milk of two other cows in the same herd and receiving the same feed was churned at 62° to 63° in order to secure the butter in the same condition and time.

Occasionally a cream has been found difficult to churn, and by raising the temperature so high as 68° or 70° Fahr., and churning until the first appearance of butter, and then lowering the temperature again to 62° to 64° better results were secured and perhaps a churning saved.

BUTTER FAILS TO GATHER.

Once in a while, even by prolonged churning, a butter that has come in exceedingly fine granules fails to gather and the particles of butter remain suspended in the milk. Such butter may usually be successfully managed by putting, at this stage, one to three quarts of a saturated solution of brine in the churn with the milk and giving the churn a few more revolutions when the granules will often come out splendidly. When butter comes in this condition we have often noticed that the serum holding the particle of butter was very viscous or sticky and the butter particle failed to aggregate into granules. The addition of the brine served to destroy this viscous property and allow of the formation of the butter granules.

MILK AND CREAM.

Ash Constituents.

The question is not infrequently asked how much nitrogen, phosphoric acid, potash, lime, etc., is contained in milk and cream? In order to answer this question I have made analyses of both milk and cream, as produced at the Station. As milk is creamed at the Station by the submerged process, by weight the cream has averaged almost twenty per cent. Hence 2,000 pounds of milk would give 400 pounds of cream, and 6,000 pounds of milk, which may be considered a good annual yield per cow, would be 1,200 pounds cream. The amount of the leading constituents removed in the milk and cream would be as follows:

	POUNDS CONTAINED IN MILK.		POUNDS IN CREAM.	
	2,000 lbs.	6.000 lbs.	400 lbs.	1,200 lbs.
Nitrogen N	14.0	42.0	2.12	6.36
Phosphoric acid P_2O_5	6.0	18,18	.60	3.02
Potash K_2O	3.38	10.14	.36	1.80
Lime CaO	4.85	14.55	.44	2.20
Magnesia MgO	.29	.87	.02	.10
Soda Na_2O	1.41	4.23	.38	1.90

Having determined the amount of these several constituents in milk and the cream from the same, we find there would be left in the skim milk derived from 2,000 pounds and 6,000 pounds of full milk as follows:

	In 1,600 lbs. skim milk.	In 4,800 lbs. skim milk.
	Pounds.	Pounds.
Nitrogen N	11.88	35.64
Phosphoric acid P_2O_5	5.46	15.16
Potash K_2O	3.02	8.34
Lime Ca O	4.41	12.35
Magnesia Mg O	.27	.77
Soda Na_2O	1.03	2.33

The amount of ash or of nitrogen in butter is almost nothing, the quantity present being too small for consideration from our present standpoint.

From the tables presented we may judge pretty closely of the amount of fertility removed from our soil by the sale of milk, cream and butter. By feeding the skim milk upon the farm, and selling the cream, we only remove about one-tenth as much as would be found in the whole milk. If the skim milk and buttermilk are all consumed upon the farm, and only the butter sold, then the amount of fertility sold from the farm in the way of nitrogen, phosphoric acid, potash and lime is almost nothing.

POUNDS OF CREAM FOR ONE POUND OF BUTTER.

The number of pounds of cream for one pound of butter will vary for individual animals and for herds under like conditions of creaming. Different methods of creaming the milk will give different results. Below are given the average number of pounds of cream for each month required to produce one pound of butter in the Station herd. The Cooley system of creaming the milk was used, and the skim milk drawn down as close to the cream as possible.

	Lbs. cream for one lb. of butter.
January	3.53
February	3.67
March	3.94
April	4.00
May	3.82
June	4.16

	Lbs. cream for one lb. of butter.
July	4.16
August	4.14
September	4.16
October	3.99
November	4.36
December	3.83

The variation by month was from 3.53 pounds of cream for one pound of butter in January, to 4.36 pounds in November. Under like conditions of creaming, the weight of the cream was not a true guide as to the amount of butter to be produced.

POUNDS OF MILK FOR ONE POUND OF BUTTER.

For the same cows the average number of pounds of milk for one pound of butter for the first seven months averaged for each month as follows:

	Lbs. milk for one lb. butter.
January	16.70
February	16.58
March	17.91
April	21.01
May	21.73
June	20.28
July	22.56

After July the conditions were such that the record is not sufficiently complete to furnish the necessary data.

INFLUENCE OF TEMPERATURE ON CREAMING MILK SUBMERGED.

It is an important practical question to know to what extent variation in the temperature of the water in the vat affects the creaming of milk.

In order to test this point milk was set on alternate days in ice water and then in water at the temperature of the spring water supplied to the dairy. The temperature of the spring water was 56° Fahr.

Analyses of the skim milk were made each day, and it was found that for the trials made when the milk was submerged in spring water there remained an average of 1.18 per cent of fat in the skim milk, and the variation of fat was from .78 per cent to 1.51 per cent, or on the average about one-fourth of the total fat present in the milk was lost. When ice was used the per cent of fat remaining in the skim-milk averaged .51 per cent for the trials made. The variation in per cent of fat was from .33 to .83 per cent. The loss in fat was about one-ninth of that present in the milk as against one-fourth at the temperature of the spring water. Fully three-fourths of a pound more of butter per 100 pounds of milk was secured by the use of ice in the water.

Milk submerged in spring water.

Time set.	Fat in skim milk. Per cent.
Twenty-four hours	1.12
Twenty-four hours	.82
Twenty-four hours	1.35
Twenty-four hours	1.49
Twelve hours	1.51
Twelve hours	.78
Average	1.18

Milk submerged in ice water.

Time set.	Fat in skim milk. Per cent.
Twenty-four hours	.40
Twenty-four hours	.83
Twenty-four hours	.33
Twenty-four hours	.42
Twelve hours	.46
Twelve hours	.65
Average	.51

INFLUENCE OF FOOD ON THE BUTTER.

During the past two years a number of feeding experiments have been conducted with milch cows, using various grain foods in order to determine something of the influence of these foods on the amount of butter produced and on the quality. The results of these trials are given in this and former reports, but we may in a general way state what seems to be the average results for the several trials with five animals. The cows experimented with being three Jerseys and two natives or no breed animals.

When hay alone was fed the yield of milk, and butter as well, was always the lowest. The addition of eight pounds of corn meal per day increased both the flow of milk and the yield of butter over that of hay alone, but the butter fat in the milk, as shown by analysis, did not increase in proportion to the yield of milk. The substitution of five pounds per day of linseed meal for six pounds of the corn meal, making the grain ration two pounds of corn meal and five pounds of linseed meal, gave a smaller yield of milk than when corn meal alone was fed. The yield of butter fat nevertheless was increased in every trial with linseed meal, and in the case of two cows with the same relative increase would amount to more than seventy pounds of butter per year for each cow.

Replacing the five pounds of linseed meal with eight pounds of wheat bran the milk yield was rather less on the whole, but in one case more than when linseed meal was fed. The yield of butter was considerably diminished. To illustrate more fully I repeat the following from my notes. In the first period there was fed hay *ad libitum*, corn meal and wheat bran:

Milk per day, twenty pounds seven ounces; milk for one pound butter, 21.3 pounds; butter per day, 15.4 ounces; per cent water in butter, 12.79.

In the second period linseed meal replaced the corn meal, otherwise the feed was the same as in period one:

Milk per day, twenty pounds one ounce; milk for one pound of butter, 16.2 pounds; butter per day, 18.5 ounces; per cent water in butter, 12.65.

A slight falling off in milk and an increase in butter, and 5.1 pounds less milk required to produce a pound of butter. The gain secured in this case would amount to 70.6 pounds of butter per year. The substitution of oats for the linseed meal was followed by smaller milk yield and less butter, but of superior quality to that from linseed-meal feed.

The experiments with ensilage and cotton-seed meal have not been repeated a sufficient number of times to warrant any definite conclusions. With ensilage, the chief difference noted was the more efficient recovery of the fat in the butter, and the butter under cotton-seed meal was of much better quality than when linseed meal was fed. From observation of the butters, and from the examination of the chemical composition of the butter fats, I should grade the quality of the butter as found in these experiments, as follows :

	First.	Second.	Third.	Fourth.	Fifth.	Sixth.
Yield.....	Linseed meal.....	Cotton-seed meal.	Corn meal..	Wheat bran.	Oats..........	Hay.........
Color.....	Oats....	Cotton-seed meal.	Corn meal...	Wheat bran.	Linseed meal.	Hay.........
Grain	Corn meal	Cotton-seed meal.	Wheat bran.	Oats.........	Linseed meal.	Hay.........
Firmness.	Cotton-seed meal.	Wheat bran.......	Corn meal...	Oats.........	Hay	Linseed me'l

By firmness, as here used, I mean that quality of hardness fitting the butter for table use. Oats produced the hardest butter, but it was somewhat crumbly. Linseed meal gave the softest butter, and its oily nature did not recommend it as first-class for table use. These results are only given tentatively until further trials can establish the true order.

I do not wish to be understood as saying that any one particular food is best adapted to produce the highest quality of butter. In fact, the finest quality of butter was produced when several of these foods were combined in a ration.

Of all grain foods tried, gluten meal gave the largest flow of milk, but the per cent of fat was exceptionally low. Dry feed, a waste product from the manufacture of starch and glucose from corn, ranked next to gluten meal. Corn meal followed these for producing flow of milk. Linseed meal gave the largest amount of butter, but the quality was not of the best, being too soft. Oats gave the best colored and hardest butter, but somewhat crumbly. A combination of foods was the most satisfactory butter ration.

Then in the feeding trials made with six individual animals we find that the character of the food did largely influence both the yield of butter and the quality. Or quoting from the last annual report to the Station: "I do not mean to be understood as saying that difference in food will make a good butter cow from an inferior animal, but rather that improper food fed to a good cow will result in a lessened quantity and an inferior quality of butter."

As the production of butter fat seems to depend upon the rapid growth of certain cells in the milk gland and these, as cells, are largely nitrogenous, we should expect the character of the food to influence, to a greater or less extent, the fat of the milk ; such seems to be true for our trials, and we have further found that certain nitrogenous foods have produced the greatest amount of butter fat.

We are aware that many trials with a large number of animals are necessary to establish a single fact, where the conditions are of such a complex nature as we have to deal with in all physiological questions and for that reason we ask that judgment may not be passed upon these results until further experiments may enable us to study more fully this question, and the results of other investigators be secured to verify our own results or to point out the source of our error.

REPORT OF FARM SUPERINTENDENT.[*]

The farm superintendent has been employed a large portion of the time for the past year in attending to the details of the stable work, finishing the basement of the new barn, building the manure platform, and in the general work of the farm and on the experimental plats.

He has also kept the meteorological and soil temperature records and had charge of the lysimeters.

The work on the farm has gone on in harmony with the plans laid out in last year's report. While crops produced have in the main been satisfactory, the conditions of the season have been such that there was an alternative between seeing them choked with weeds or putting more than an ordinarily profitable amount of work into cultivation by hand. The latter was chosen and the farm is now as clean of weeds, generally speaking, as could be expected after so favorable a season for their growth. The wild carrot has appeared and although it has been suppressed wherever found in bloom, we can hardly hope to escape a general crop of it with so much as is allowed to produce seed near the farm, for its seeds will be blown about and lodge from the winds where many a one will find a foothold in spring.

The continued prevalence of wet weather encouraged the growth of fungous plants to such an extent that a parasite of this kind entirely ruined the oat crop of this farm, and the crop of this region is reported as "light," presumably from similar cause.

Among minor improvements on the farm has been the removal of all interior fences which are not needed to inclose the stock. The old fence boards were made into panels on stormy weather when little else could be done. These are ready to help inclose the orchard temporarily while pigs or sheep are turned in to consume windfalls and thus lessen insect depredators.

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[*] F. E. Emery.

Below is a synopsis of the work which is reported in the following pages:

Grass plats and forage crops.
Potato experiments.
Fertilizer experiment with corn.
Corn in hills, drills and broadcast.
Variety test of corn for fodder in this locality.
Variety test of beets for fodder in this locality.
Variety test of carrots for fodder in this locality.
Fertilizer experiments with grass.
Relative yields of four varieties of barley.
Warm water for milch cows.
Subsoiling experiments.
The manure platform.
The lysimeter record for 1889.
Notes on fluctuation in an unused well.
Meteorology for 1889.

GRASS PLATS AND FORAGE CROPS.

The small grass plats have been continued as they were last season, save that where some have failed they have been replaced by seed of the same or another variety.

Last year the festucas presented so varied an appearance that seeds were saved and sown from the different forms. These have grown well for their kind, but none have shown any tendency to panicle.

The number of different grasses grown has been increased the past season by seed from various sources (see "Gifts to the Station"), so that there have been thirty-one families represented by sixty-five species and varieties not including a few which may prove to vary too little from the type to be regarded even as varieties.

While keeping so many varieties separate and clean costs much time and care, yet it is fully repaid by the object lesson which it constitutes to all who have interest enough to look at them. Here one can see the grasses with which he is familiar growing beside others which he has never regarded as worthy of cultivation, but which, under like conditions, are equally good or perhaps better. A careful examination of these plats might well be the first step towards improving the fields and pastures of many farms in any county of the State.

The species and varieties included in the following list have been growing on the plats the past season:

Agropyrum glaucum; Ag-ro-py-rum glaú-cum. (Blue Stem.)
A. repens; ré-pens. (Couch, Quake, Quick, etc.)
A. ——— ———? (Bennett's Native Wild Rye.)
Agrostis canina; A-gros-tis ca-ní-na. (Brown Bent, Dog's Bent, Mountain Red Top.)
A. stolonifera; stó-lon-if-er-a.
A. vulgaris; vul-gá-ris. (Red Top, Herd's Grass in Penn., Finetop, Burden's Bent, Rhode Island Bent.)
Alopecurus agrestis; Al-o-pe-cú-rus a-gres-tis.
A. pratensis; pra-ten-sis. (Meadow Foxtail.)
Anthoxanthum odoratum; An-thox-an-thum o-do-rá-tum. (Sweet Vernal, Sweet Scented Vernal.)
Asprella hystix; Asprel-la hys-tix,
Avena elatior; A-vé-na e-lá-ti-or. (Tall Meadow Oat Grass.)
A. flavescens; fla-ves-cens. (Yellow Oat Grass.)
A. flavescens flexuosa; flex-u-o-sa.
Bouteloua oligostachia; Bou-te-loú-a ol-i-gos-tach-ia. (Mesquite or Buffalo Grass.)
Bromus ciliatus; Bró-mus cil-i-a-tus.
B. secalinus; sec-a-li-nus. (Chess, Cheat.)
B. Schraderii; Schrá-der-ii. (Schrader's Brome Grass.)
B. pratensis; pre-ten-sis.
Calamagrostis. (See Deyeuxia.)
Cynosurus cristatus; Cyn-o-su-rus cris-tá-tus. (Crested Dog's-tail Grass.)
Dactylis glomeata; Dac-tyl-is glom-er-á-ta. (Orchard Grass.)
Deschampsia caespitosa; Des-champ-si-a caes-pi-tó-sa. (Hair Grass.)
Deyeuxia sp?; De-yeux-i-a. (Mountain Blue Joint.)
Evagraster Abyssinica. (Theff., Red var., White var.)
Festuca elatior; Fes-tú-ca e-lá-ti-or. (Tall Fescue.)
F. ovina; o-ví-na. (Sheep's Fescue.)
F. ovina, var. duriuscula; du-ri-us-cú-la. (Hard Fescue.)
F. ovina, var. rubra; rú-bra. (Red Fescue.)
F. ovina, var. heterophylla; het-e-ro-phyl-la.
F. ovina, var. nutans; nú-tans.
F., No. 1.
F. pratensis; pra-ten-sis.

F. tenuifolia; ten-u-i-fó-li-a.
Fort Bellingham Grass.
Glyceria fluitans; Gly-ce-ri-a flu-i-tans.
G. nervata; ner-va-ta.
Koelaria cristatus; Koe-lá-ri-a cris-tá-tus.
Lolium Paceyii; Ló-li-um Pá-cey-ii. (Pacey's Rye Grass.)
L. perenne; pe-ren-ne. (Rye Grass, Italian Rye Grass.)
Muhlenbergia mexicana; Muh-len-berg-i-a mex-i-cá-na.
Panicum proliferum; Pan-i-cum pro-lif-er-um.
Phalaris arundinacea; Phal-á-ris a-run-di-ná-ce-a. (Reed Canary, Ribbon.)
Phleum alpinum; Phlé-um al-pí-num. (Mountain Timothy.)
P. pratense; pra-ten-se. (Common Timothy.)
Poa aquatica; Pó-a a-quat-i-ca. (Water Meadow Grass.)
P. arachnifera; a-rach-ni-fé-ra. (Texas Blue Grass.)
P. compressa; com-press-a. (Wire Grass.)
P. nemoralis; nem-o-rá-lis. (Wood Meadow Grass.)
P. pratensis; pra-ten-sis. (June Grass, Kentucky Blue Grass.)
P. serotina; ser-ó-ti-na.
P. trivialis; triv-i-á-lis. (Rough Stalked Meadow Grass.)
Sorghum halapense; Sor-ghum hal-a-pense. (Johnson Grass.)
Stipa spartea; Stí-pa spar-te-a. (Porcupine Grass.)
Triticum. (See Agropyrum.)

CLOVERS.

Hedysarum onobrychis. (Same as O. sativa?) Hedy-sá-rum on-o-bry-chis.
Lotus corniculatus; Lo-tus cor-ni-cú-la-tus.
L. villosus; vil-ló-sus.
Medicago lupulina; Med-i-cá-go lu-pú-li-na. (Black Medick.)
M. sativa; sa-tí-va. (Alfalfa or Lucerne.)
Melilotus alba; Mel-i-ló-tus al-ba. (Bokhara Clover.)
M. cerulea; ce-rú-le-a. (Honey or Bee Clover.)
Onobrychis sativa. (Sanfoin.) On-o-bry-chis sa-tí-va.
Trifolium hybridum; Tri-fó-li-um hy-brid-um. (Alsike Clover.)
T. incarnatum; in-car-ná-tum. (Crimson Trefoil or Scarlet Italian.)
T. incarnatum a fleur blanche.
T. pratense; pra-ten-se. (Common Red.)

Trifolium repens; ré-pens. (White Clover.)
Achillea milefolium. (Yarrow or Milfoil.) A-chillea mil-e-fo-li-um.
Echinops sphearocephalus. Chapman Honey Plant.

The past season has been a good one for grasses which have made an excellent growth. There has been no occasion to discredit the good words said of any grass in the last report, while several others have shown qualities deserving of special mention. Among these might be mentioned Meadow Foxtail, Orchard and Oat grasses and Sheep's Fescue for pasturage, and the Rye grasses which have headed out the third time during the season.

A number of grasses have made growth enough from spring seeding to make a considerable crop of hay.

The clovers have done very poorly owing to the prevalence of fungus. Samples of affected plants were shown by Professor William R. Dudley, of Cornell University, to be supporting Uromyces trifolii. These parasites destroyed all the later growth of clover, killing the leaves nearly as fast as they were developed.

The Yarrow or Milfoil came to us with seeds from Germany, where it is said to be used as a forage crop.

LARGE PLATS.

Old series.

These plats were top dressed in the fall of 1888, and have this season all been cut over the second time, because of the heavy growth which we deemed desirable to remove. Below is the record of crops taken off, with a repetition of the seeding, and notes on what were the most prominent grasses as evident to the casual observer. A minute determination of the crop on a square foot or yard, might result in changing some of the relative positions. The most abundant grass is placed first:

HAY FROM LARGE GRASS PLATS — SERIES A — UPPER.

PLAT.	Grasses sown, 1886.	Leading grasses, 1889.	FIRST CROP.		SECOND CROP.		THIRD CROP.		Total crop.	Yield per acre.
			Date cut.	Yield.	Date cut.	Yield.	Date cut.	Yield.		
				Lbs.		Lbs.		Lbs.	Lbs.	Lbs.
A 1, upper	Perennial Rye grass, Alsike Clover, one-half.	Alsike Clover, Perennial Rye grass, Timothy.	June 22	330.0	Oct. 2	112.0	....	......	442.0	9324.0
A 2, upper	Water Meadow grass, Red Top, one-half each.	Red Top Timothy, White Alsike and Red Clovers, Water Meadow and Orchard Meadow Fescues, and a few stools of Reed Canary grass.	July 13	232.0	Oct. 2	44.0	....	......	276.0	6072.0
A 3, upper	Kentucky Blue grass, Meadow Fescue, one-half each.	Meadow Fescue, Timothy, Kentucky Blue, White, Alsike and Red Clovers.	June 20	290.0	Oct. 2	120.0	....	......	410.0	9020.0
A 4, upper	Italian Rye grass, Timothy, one-half each.	Timothy, Clover, Rye grass, Quack, Orchard, and species of Fescue.	July 13	308.0	Oct. 2	80.0	....	......	388.0	8536.0
A 5, upper	Spiked Fescue, Sweet Vernal, one-half each.	Spiked Fescue, White, Alsike and Red Clover, Sweet Vernal, Timothy, Orchard, Oat and Melotus.	June 20	250.0	Oct. 2	136.0	....	......	386.0	8492.0
A 6, upper	Pacey's Rye grass, Various-leaved Fescue grass, one-half each.	Fescue and Orchard grasses.	June 7	156.0	Oct. 2	26.0	....	......	182.0	4004.0
A 7, upper	Orchard grass, Meadow Fescue grass, one-half each.	Orchard and Fescue grasses and Clovers.	June 7	128.0	Oct. 2	126.0	....	......	254.0	5588.0
A 8, upper	Wood Meadow grass, Creeping Bent grass, one-half each.	....	June 7	70.0	Oct. 2	104.0	....	......	174.0	3228.0
A 9, upper	Yellow Oak grass, Meadow Foxtail grass, one-half each.	Meadow Foxtail and White Clover.	May 16	108.5	July 13	126.0	Oct. 2	56.0	290.5	6391.0
A 10, upper	Crested Dogstail grass, Purple Fescue grass, one-half each.	Sheep Fescue and White Clover.	June 7	50.0	Oct. 2	22.0	....	......	72.0	1584.0
A 11, upper	Rough-stalked Meadow grass, Foul Meadow grass, one-half each.	Timothy, Quack, White Clover and Meadow grass.	July 13	260.0	Oct. 2	34.0	....	......	294.0	6468.0
A 12, upper	Italian Rye, Red Top, Timothy, Tall Fescue, Meadow Foxtail, Perennial Rye, Yellow Oat grass, one pound each.	Meadow grass, very little Timothy, Orchard or Rye grasses, and very little Clover.	June 20	228.0	Oct. 2	162.0	....	......	390.0	8580.0
A 13, upper	Rough-stalked Meadow, Sweet Vernal, Crested Dogstail, Pacey's Rye, Poa pratensis Meadow and Various-leaved Fescues, one pound each.	Fescue, Kentucky Blue and Quack grasses, White, Alsike and Red Clovers.	June 20	236.0	Oct. 2	94.0	....	......	330.0	7260.0

ALFALFA AND PRICKLEY COMFREY.

PLAT.	Grasses sown, 1886.	Leading grasses, 1889.	FIRST CROP.		SECOND CROP.		THIRD CROP.		FOURTH CROP.		Total crop.	Yield per acre.
			Date cut.	Yield.	Date cut.	Yield.	Date cut.	Yield.	Date cut.	Yield.		
				Lbs.		Lbs.		Lbs.		Lbs.	Lbs.	Lbs.
A, gore..........	Alfalfa...........	Green weight.....	May 10, 11, 13	496.0	July 6	714.0	Aug. 16	456.0	Oct. 5	216.0	1882.0	32888.0
Cherry orchard.	Alfalfa...........	Green weight.....	May 16 to June 3	2194.0	July 4 to 24	8333.0	Aug. 17 to 27	5828.0	Oct. 5 to 10	2802.0	19151.0	Nearly one acre.
Cherry orchard.	Alfalfa...........	Hay...............	June	2116.0	....	......	....	......	....	......	2116.0	
A 14, upper.....	Prickly comfrey.	Green weight.....	May 16	466.0	June 24	476.0	Aug. 10	490.0	....	......	1430.0	28640.0
B 1..............	Prickly comfrey.	Green weight.....	May 16	558.0	June 25	1060.0	Aug. 6	890.0	....	......	2508.0	25080.0

Meadow Foxtail on plat 9 was the earliest grass to bloom and be ready to cut for hay. The crop was light, but this was retrieved by rapid growth and three cuttings. The many leaves and few culms of this grass, combined with its earliness and rapid growth after being cut back, make it one of the best pasture grasses.

The crops of Alfalfa and Prickly Comfrey have been given in a separate table. Last year's trials of Prickley Comfrey for hay and ensilage have been repeated. Although some of the leaves were preserved fresh in silo, yet we can not call this a successful plant for ensilage or for hay. Three crops were used in these trials, and as green food for the cows, but the fourth crop, which was about equal to those cut not being needed for feed, was allowed to stand until frosted, and has not been harvested.

There was too little of our Comfrey to pay for the trouble of analysis, or it would have been used along with the other crops for the young stock.

Plat 10 was one of the earliest to be ready to cut, and gave the lightest crop. After haying the growth of grass came on slowly, but no one could have examined it closely without remarking the heavy mat of grass and white clover which covered the whole plat. It was so close and dense that the scythe failed to get it the second time it was cut over. This Fescue seems to be fitted for close grazing.

Alfalfa, spring rye, barley, peas and oats, Hungarian grass and corn have been used as soiling crops. Alfalfa has been, however, the mainstay, having been the first thing ready to feed in spring, and the fourth crop the last in fall.

Second or new series.

A few of the series of plats, known as A lower, were seeded last spring to a new set of grass seed mixtures, one-half of each with and half without grain, which was cut as a forage crop. The rye did not make a large growth, and, as it was cut early, the grass seed was not shaded as would generally be the case with grass sown with a grain crop. Owing probably to the short time the rye was on the ground, and the moist season, there is little difference in the appearance of the two halves of each plat. All the plats have been mowed with the machine, but no weights taken of the crops, since those from all but where Sweet Clover and Johnson grass were sown, consisted largely of weeds and summer grasses.

Below is given the kind and amount of seed used for each half plat:

GRASS SEED SOWN ON PLATS A LOWER.		Per plat.	Per acre.
A 1, W. half, with rye.	Tall Oat grass (Avena elatior)..	1 lb.	40 lbs.
E. half, with rye.	Orchard grass (Dactylis glomerata).........................	10¾ ozs.	26⅞ lbs.
A 2, W. half, with rye.	Tall Oat grass (Avena elatior).	10¾ ozs.	26⅞ lbs.
E. half, no rye.	Orchard grass (Dactylis glom.).	10¾ ozs.	26⅞ lbs.
A 3, W. half, with rye.	Timothy (Phleum pratense)....	6 ozs.	15 lbs.
E. half, no rye.	Timothy (Phleum pratense)....	4 ozs.	10 lbs.
A 4, W. half, with rye.	Tall Oat and Orchard grasses..	8 ozs.	20 lbs. each.
E. half, no rye.	Tall Oat and Orchard grasses.	5½ ozs.	13¾ lbs. each.
A 5, W. half, with rye.	(Festuca elatior).................	10 ozs.	25 lbs.
E. half, no rye.	(Festuca elatior)	7 ozs.	17½ lbs.
A 6, W. half, with rye.	Meadow Foxtail grass (Alopecurus pratensis)..............	1½ lb.	60 lbs.
	Kentucky Blue grass (Poa pratensis)	¾ lb.	30 lbs.
E. half, no rye.	Same as W half................	1 lb. ½ lb.	40 lbs. 20 lbs.
A 7, W. half, with rye.	Red Top, Timothy, Kentucky Blue..........................	1 oz. each.	2¼ lbs. each.
	Sweet Vernal, Meadow Foxtail, Festuca elatior and Tall Oat grass	2 ozs. each.	5 lbs. each.
E. half, no rye.	Red Top, Timothy and Kentucky Blue....................	¾ oz.	1⅞ lbs. each.
	Remainder of same grasses...	1½ oz.	3¾ lbs. each.
A 8, W. half, with rye.	Orchard grass..................	8 ozs.	20 lbs.
	Kentucky Blue grass...	6 ozs.	15 lbs.
E. half, no rye.	Orchard grass..................	5½ ozs.	13¾ lbs.
	Kentucky Blue grass..........	4 ozs.	10 lbs.
A 9, W. half, with rye.	Reed Canary grass (Phalaris arundinacea)............. ...	1 lb.	40 lbs.
	Sweet Clover (Melilotus alba).	½ lb.	20 lbs.
E. half, no rye.	Reed Canary....................	10¾ ozs.	26⅞ lbs.
	Sweet Clover....................	5 1-5 ozs.	13¾ lbs.
A 10, W. half, with rye.	Johnson grass (Sorghum halapense).........................	1 lb.	40 lbs.
	Sweet Clover....................	½ lb.	20 lbs.
E. half, no rye.	Johnson grass..................	10¾ ozs.	26⅞ lbs.
	Sweet Clover....................	5½ ozs.	13¾ lbs.

POTATO EXPERIMENTS.

It has been a matter of observation for years that the potato crop depends very much on climatic conditions. That is, the variation of a few days in the planting may bring the setting of the tubers before, within or after the hot, dry period which midsummer seldom fails to bring, and thus determine largely the amount of crop which can be grown. As no one can foretell the weather with certainty, it seems best to plant at such time as will be likely to bring the critical period of growth before or after the unfavorable weather. We can not expect to plant a large crop so the conditions will be right for the whole, but if some time intervenes between the first and last planting a part of the crop will usually prove much more prolific than another, with no apparent cause in the soil for such difference. With this idea in mind a difference of nearly two weeks was purposely made in the planting of the F and B series of plats which enter into this examination.

A comparison of the yields from the F and B series shows a difference like that referred to very distinctly, but partially due, perhaps, to a decrease in the rate of seeding in three of the forms used. This difference of growth from climatic condition has this year been very materially interfered with, or helped, by potato "blight" or "rot," which attacked the two series at about the same time and at a very different stage of growth. The tubers in the most prolific rows of the B plats seemed to be quite as numerous as in the F plats, but they were very much smaller, which would seem to indicate that either the dry weather checked their growth, or having escaped that, the blight checked their growth. In any case there is as much fairness for one side as another in the following experiments.

The F plats were planted May fourth, while the B plats were not planted until May sixteenth, seventeenth, eighteenth and twentieth. B 8-13 on the sixteenth, B 13-14 on the seventeenth, B 6 and 7 on the eighteenth and B 15 and 16 on the twentieth.

Plats F 3 to 12 and B 8 to 12 are fertilizer plats seeded alike, so they can be compared without interference when regarded as whole plats, as well as in the case of seeding trials, where there are two rows on each plat devoted to different amounts of seed.

Plats B 6 and 7 are devoted to fertilizer below and above the seed, but have the comparison by adjacent rows which have equal weight of seed. These are combined for each plat, and they are added to the trial on methods of seeding. B 13 and 14 are also planted with different amounts of seed and by different methods, as above, but the two rows having the same amounts of seed are planted on the surface and in a furrow, and like treatment given in other respects. B 15 and 16 are planted with such equal weight of seed that half of each can be used in the main trial for methods of seeding, but the other halves, on which the same weights are in three times as fine state of division, are not used.

Colorado beetles (*Doryphora* 10-*lineata*, Say) attacked the plants as soon as they were out of the ground, and were hand-picked for a time. Then London purple was sprayed on the foliage, using a force pump and Nixon nozzle, with a barrel in a one-horse wagon. This proved fairly satisfactory on the plats where the rows were short and the operator could reach half of two plats by passing between them. Four ounces to fifty gallons of water was first applied, then the strength increased to five to six and to eight ounces to every fifty gallons of water, before satisfactory work was done. The strongest solution did not noticeably injure the foliage but did kill off the beetles. It did not, however, have much effect on the Flea beetles (*Haltica Striolata*) which attacked the foliage, perforating the leaves so thickly as to give them a speckled appearance.

METHODS OF SEEDING.

The experiments planned to add data to the knowledge already gathered in determining the amount of seed which is most profitable for the grower to plant, were conducted as follows:

1. WHOLE TUBERS *vs.* CUTTINGS FOR SEED.

The seed tubers used were of the White Star variety which has been grown at the Station for several years. These were planted as whole tubers, half tubers, three-eye cuttings, two-eye cuttings and one-eye cuttings, and with equivalent weights of seed in all rows in which the form was alike. These five different methods of seeding were arranged in single rows in the order given above, and the set of five rows repeated on each plat. Thus every twentieth acre plat consisted of two rows of each form of seed. When a full stand was obtained each row contained thirty-three hills. Where any hills were missing, the average of those harvested has been taken as their probable yield, and each is thus calculated to a full stand.

In order to show the proportion of a full stand secured by each form of seed, the whole number of hills which were missing at harvest and the per cent of each is shown in the following exhibits:

EXHIBIT A.

	Whole tubers.	Half tubers.	Three eyes.	Two eyes.	One eye.
Plat F 3	0.	0.	0.	1.	5.
Plat F 4	0.	0.	0.	1.	4.
Plat F 5	0.	0.	2.	0.	2.
Plat F 6	0.	0.	0.	2.	2.
Plat F 7	0.	1.	0.	1.	7.
Plat F 8	0.	0.	0.	0.	2.
Plat F 9	0.	0.	0.	0.	3.
Plat F 10	0.	0.	0.	0.	0.
Plat F 11	0.	0.	1.	1.	2.
Plat F 12	0.	0.	0.	0.	4.
Per cent of hills missing	0.0	0.15	0.45	0.90	4.70

Exhibit B.

	Whole tubers.	Half tubers.	Three eyes.	Two eyes.	One eye.
Plat B 6	0.	2.	9.	18.	68.
Plat B 7	1.	2.	6.	33.	67.
Plat B 8	0.	0.	2.	3.	18.
Plat B 9	0.	2.	3.	3.	35.
Plat B 10	0.	0.	0.	4.	17.
Plat B 11	0.	1.	3.	12.	22.
Plat B 12	0.	2.	0.	3.	15.
Plat B 13	0.	3.	4.	11.	35.
Plat B 14	0.	3.	4.	10.	31.
Half of 15 and 16	1.	0.	2.	6.	15.
Per cent of hills missing	0.15	1.13	2.5	7.8	24.5

While there was no regularity in the vegetation or blossoming, on the whole the cut seed was later than the whole seed, and the finer it was cut the more was this difference.

Early in the season the tops, where whole and half seed had been planted, made a good, strong, bushy growth, but there was almost a regular gradation from the rows where whole and half seed was planted, down to the row in which the seed was one eye per hill, and in the latter the tops were few and comparatively weak. This difference continued throughout the season, though considerably less marked toward the end of the time, during which the tops remained green.

Below is given the amount of seed planted per plat, and per acre by each method separately, and the aggregate shows the average rate of seeding:

Below the rate of seeding is given the amount of sound "merchantable" and "small" tubers from each plat by each method of seeding. Where there were missing hills the crop has been increased to a full stand by calculation.

At the end of each line opposite the number of the plat is given the yield of sound "merchantable" and "small" tubers per plat, and the same calculated per acre.

At the bottom are the total footings of each column, which shows the yield of "merchantable" and "small" tubers from one-tenth acre by each method of seeding. These are both calculated per acre, and combined to show total yields per acre on the last line. These calculations have been confined to sound tubers, because of the variations which could have been introduced by incorporating the weights of decayed tubers, which varied between being only partially involved, and almost or entirely consumed.

These variations occurring on almost every plat, no notes were made as to the relative difference between rows or on different plats in this respect, so there is only the record of weight of decayed tubers which in a general way agrees with the amounts of seed planted and crop produced. For the 10 F plats 3-12 inclusive the amount of decayed tubers were in pounds as given below:

	Whole tubers.	Half tubers.	Three-eye cuttings.	Two-eye cuttings.	One-eye cuttings.
F plats 3-12..............	92.2	56.33	57.59	39.18	17.12
Calculated to full stand.	92.2	56.41	57.66	39.53	17.92
B plats 6-14 and half of 15 and 16...............	99.73	30.16	13.55	10.57 11.40	19.04
Calculated to full stand.	99.88	30.50	13.89		23.70

TABLE I.

	Seed, whole tubers.		Seed, half tubers.		Seed, 3-eye cuttings.		Seed, 2-eye cuttings.		Seed, 1-eye cuttings.		Totals per plat.	Totals per acre.		
											Lbs.	Bush.		
Amount of seed used per plat by each method of seeding, lbs...	19		9½		4		2		1		35½	....		
Amount of seed used per acre by each method of seeding, bush.	31⅔		15 5-6		6⅔		3⅓		1⅔		....	11 5-6		
Missing hills on ten plats	00		1		3		6		31		....	....		
CROPS PRODUCED.	Merch.	Small.	Merch.	Small.	Merch.	Small.	Merch.	Small.	Merch.	Small.	TOTAL MERCH.		TOTAL SMALL.	
											Per plat.	Per acre.	Per plat.	Per acre.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bush.	Lbs.	Bush.
Plat F3	133.53	20.44	98.25	14.34	82.59	3.76	61.32	5.27	38.75	2.70	414.48	138.2	46.51	15.5
Plat 4	99.84	15.81	98.63	8.53	68.77	5.22	58.95	3.58	43.52	2.36	369.71	123.2	35.50	11.8
Plat 5	91.25	16.59	71.19	16.63	45.69	6.85	30.00	6.70	18.48	4.78	256.61	85.5	51.55	17.2
Plat 6	130.00	15.19	104.50	9.83	66.22	5.05	63.48	4.79	31.17	3.27	395.37	131.8	38.13	12.7
Plat 7	83.63	12.53	88.23	7.36	54.04	4.38	52.25	3.64	26.99	1.92	305.14	101.7	29.83	9.9
Plat 8	112.14	15.23	93.06	14.19	69.44	5.13	55.03	2.13	24.14	3.97	353.81	117.9	40.65	13.6
Plat 9	128.23	19.84	113.17	18.11	63.28	3.56	71.06	3.09	42.75	1.36	418.49	139.5	45.96	15.3
Plat 10	118.6	10.88	89.59	8.92	68.20	2.88	43.38	2.17	31.84	1.97	351.17	117.1	26.82	8.9
Plat 11	114.34	7.66	83.22	6.41	63.48	3.28	41.77	1.89	23.75	2.15	326.56	108.9	21.39	7.1
Plat 12	119.78	9.09	85.88	5.84	66.03	4.19	45.36	1.74	26.35	1.46	343.40	114.5	22.32	7.4
	1130.90	143.26	925.72	110.16	647.74	44.30	522.60	35.00	307.74	25.94	3534.74	1178.3	358.66	119.4
Yield per acre, bushels	188.5	23.9	154.3	18.4	108.0	7.4	87.1	5.8	51.3	4.3	....	117.8	......	11.9
Total yield per acre, bushels.	212.4		172.7		115.34		92.9		55.3		....	....	129.7	....

TABLE II.

	Seed, whole tubers.		Seed, half tubers.		Seed, 3-eye cuttings.		Seed, 2-eye cuttings.		Seed, 1-eye cuttings.		Totals per plat.	Totals per acre.		
Amount of seed used per plat by each method of seeding........	30		15		6		4		2		Lbs. 57.	Bush.		
Amount of seed used per acre by each method of seeding	25		12½		5		3⅓		1⅔		....	9½		
CROPS PRODUCED.	Merch.	Small.	Merch.	Small.	Merch.	Small.	Merch.	Small.	Merch.	Small.	TOTAL MERCH.		TOTAL SMALL.	
											Per plat.	Per acre.	Per plat.	Per acre.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bush.	Lbs.	Bush.
Plat B 6..........................	145.38	48.97	113.53	24.92	69.01	12.98	58.62	9.84	34.42	6.19	420.96	7.02	102.9	17.2
Plat 7..........................	180.49	27.58	135.79	22.08	76.29	9.72	68.58	6.78	47.34	5.59	508.49	84.8	71.75	12.0
Plat 8..........................	173.06	30.22	138.13	21.13	86.25	11.17	56.79	10.65	36.15	6.40	490.38	81.7	79.57	13.3
Plat 9..........................	186.13	22.69	135.36	16.37	65.25	13.62	65.14	7.55	32.77	5.29	484.65	80.8	65.52	10.9
Plat 10..........................	142.00	18.44	123.94	11.88	64.13	4.25	57.55	5.38	36.60	3.88	424.22	70.7	43.83	7.3
Plat 11..........................	176.81	17.50	125.76	12.78	84.04	4.80	58.92	3.92	42.37	3.60	487.90	81.30	42.60	7.1
Plat 12..........................	174.56	10.75	137.72	8.63	79.00	3.94	59.92	3.01	39.09	2.26	482.29	80.08	28.59	4.8
Plat 13..........................	130.38	24.63	90.11	14.39	41.44	8.51	28.57	3.82	11.56	4.59	302.06	50.34	55.74	9.3
Plat 14..........................	133.00	13.81	91.58	7.42	54.91	5.67	48.56	4.93	27.94	2.59	355.99	59.32	34.42	5.7
Plats 15 and 16, the half of each planted same as above combined..........................	138 21	11.38	109.25	9.07	78.33	3.77	71.38	5.12	42.97	3.33	440.14	73.4	32.67	5.4
	1580.02	225.97	1201.17	148.67	698.65	78.43	574.03	61.00	343.21	43.72	4397.08	....	557.65	....
Yield per acre (bushels)......	131.7	18.8	100.1	12.2	58.2	6.5	47.8	5.1	28.4	3.64	....	73.3	......	9.3
Total yield per acre (bushels)	150.5		112.3		64.7		52.9		32.0		....	....	82.6	....

TABLE III.

	EARLY PLANTED — F PLATS.				LATE PLANTED — B PLATS.				TOTAL CROP FROM THESE PLATS.		
	PER CENT OF CROP.				PER CENT OF CROP.				PER CENT OF CROP.		
	Merchantable.	Small.	Total.		Merchantable.	Small.	Total.		Merchantable.	Small.	Total.
One-fifth of the area produced from whole tubers for seed.....	32.0	39.9	32.7	......	35.9	40.5	36.5	......	34.2	40.3	34.9
One-fifth of the area produced from half tubers for seed.......	26.0	30.7	26.6	......	27.3	26.7	27.2	......	26.8	28.2	27.0
One-fifth of the area produced from 3-eye cuttings for seed....	18.0	12.4	17.8	......	15.9	14.1	15.7	......	17.0	13.4	16.6
One-fifth of the area produced from 2-eye cuttings for seed....	14.8	9.8	14.3	......	13.1	10.9	12.8	......	13.8	10.5	13.5
One-fifth of the area produced from 1-eye cuttings for seed....	8.2	7.2	8.6	......	7.8	7.8	7.8	......	8.2	7.6	8.1
Area required to raise 100 bushels of merchantable tubers:	Sq. rds.				Sq. rds.						
Whole tubers	84.9				121.6						
Half tubers	103.7				159.8						
Three-eye cuttings..	148.1				274.9						
Two-eye cuttings	183.7				334.7						
One-eye cuttings	311.9				563.4						

On the B plats the seeding was lighter in the three forms where the largest amounts was used, and at the same rate for two and one-eyed seed. This change was made necessary because the supply of larger tubers of even size was used up and a smaller grade was necessarily used for seed.

The B plats were double the size of the F plats, each being one-tenth acre. Hence the area covered by this experiment is one-half acre on the F plats, or one-tenth to each form and different amount of seed, and one acre on the B plats or one-fifth acre for each different amount of seed.

The yields from these small areas on each plat, all telling the same story, from the vegetation of the plants up to the harvest results, when combined, point very decidedly to one conclusion. And, when seconded by such other results as are appended, ought to carry conviction that light seeding for the potato crop is unprofitable, and that heavy seeding alone is compatible with successful work for the potato culturist.

Just how much to plant for the greatest profit depends so much on conditions of the market at both ends of the season, the fertility of the soil and other considerations that it is obvious; no definite amount can be set as the best. In the above-recorded experiment, with seed and crop at the low price of twenty-five cents per bushel, the greatest profit was with the most seed, where the seed tubers weighed an average of five ounces each.

In an experiment with many varieties on a small scale, at the Maryland Station, in 1888, the greatest rate of profit was from their greatest weight of seed, where ten-ounce tubers were planted at the rate of sixty bushels per acre.

In three years trials compiled at the same place* by far the greater profit was shown to result from whole medium-sized tubers. These three years results are so in harmony with the above that the following is abstracted from page 24 of Bulletin 2, quoted above:

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* Bulletin No. 2, Maryland Agricultural Experiment Station, 1888.

II. AVERAGE RESULTS FOR THREE YEARS.

Product per acre — Three methods of seeding.

FORM OF SEED POTATO.	1885.	1886.	1888.
Whole potato, egg size	316.0	354.0	174.36
Usual cutting, one piece	215.5	223.87	134.24
Single eye, on fair-sized piece	185.5	109.66	90.53

The general result is thus emphasized: THE MORE SEED POTATO PLANTED THE MORE AND BETTER THE CROP.

Since the Maryland Station has compiled a table of all the accessible Station results on this question of seed potatoes, it is here reproduced as embodying much information not elsewhere easily obtained by our readers. The lines numbered 18 and 19 have been incorporated from our later results.

It will be seen that the above emphasized quotation is almost invariably true.

Comparing with the results obtained at this Station figures relating to similar experiments made elsewhere, we find much corroborative testimony as to the truth of the statement that *the more seed potato planted the greater the crop.*

On the opposite page we give the figures and the sources from which they were obtained:

Number.	(TABLE V.)	Thin paring.	Single eyes cut close.	Single eyes.	Two eyes.	One-fourth of a potato.	Three-eyes.	One-half of a potato.	Whole small potato.	Whole potato.	
1	Report N. Y. Exp. Station, 1885.			156 lbs. 10 oz		232 lbs.	†218 lbs. 5 oz.				Yield of large tubers.
2	Report N. Y. Exp. Station, 1886.			163 lbs. 8 oz.	206 lbs. 12 oz.		217 lbs. 4 oz.				Yield of large tubers.
3	Report N. Y. Exp. Station, 1887.			337½ lbs.			400 lbs.	450 lbs.			Yield of large tubers.
4	Report N. Y. Exp. Station, 1882.			82 bush.				86 bush.			Yield of large tubers.
5	Report N. Y. Exp. Station, 1883.			137 bush.		181 bush				195 bu	Yield of large tubers.
6	Report N. Y. Exp. Station, 1882.		2.8 bush.			67.3 bush.					Yield of large tubers.
7	Report N. Y. Exp. Station, 1883.		110.5 bush.	154.8 bush.							Yield of large tubers.
8	Report Wis. Exp. Station, 1883.	64 lbs.	*103½ lbs.	106½ lbs.				‡113 lbs.			Yield of large tubers.
9	Report Mo. B'd of Agr., 1886-87.			104.2 bush.	105.3 bush.	170.8 bush.			124.1 bush	172.7 bu.	Yield of large tubers.
10	Report Mo. B'd of Agr., 1886.		70.4 bush.	135.3 bush.							Yield of large tubers.
11	Bulls. 13 and 34 Mich. Ag'l Col.			77 lbs.	107.5 lbs.		136 lbs.	136.25 lbs.		152.6 lbs	Yield of large tubers.
12	Report Cornell University Exp. Station, 1879-80				84 lbs.			93 lbs.	80 lbs.	85 lbs.	
13	Report Cornell University Exp. Station, 1883-85			109.6 lbs.						119.2 lbs	
14	Report Mass. Exp. Station, 1884.							973⅓ lbs.		1012.0 lbs	
15	Report Ohio Exp. Station, 1884.			130.1 bush.						245.7 bu.	
16	Report Ohio Exp. Station, 1885.			111.8 bush.						239.6 bu.	
17	Maryland Exp. Station, 1888		53.1 bush.	58.9 bush.		82.7 bush.			106.7 bush	172.1 bu.	
18	Report N. Y. Exp. Station, 1888.			180¼ lbs.	193 lbs.		262 5-12 lbs.	332 1-6 lbs.	272⅓ lbs.		Yield of large tubers.
19	Report N. Y. Exp. Station, 1889.			39.9 bush.	67.5 bush.		83.1 bush.	127.2 bush.	125.4 bush	151.0 bu.	Yield of large tubers.

* Thick paring.

† One-third of a potato.

‡ Average of results from planting seed end and stem end.

Numbers 2, 3 and 18 in this table give the results of a trial to test the difference in productiveness of one, two and three-eye pieces, respectively, compared with whole tubers of the same weight. The figures given here are the average of the yields obtained from each piece and the corresponding whole tuber.

In No. 7 we have in the single-eye column the average of single eyes cut "deep" and "half deep," as against the same cut "shallow" or "close."

Numbers 9 and 10 give averages of results tabulated in the Report of the Missouri State Board of Agriculture for 1886–87, pages 55 and 56.

Number 11 is the average of the two reports in the bulletins named.

Number 14 gives the average of three plots of each of the two methods of seeding.

2. SIMILAR WEIGHTS OF SEED PER ROW IN HILLS AND DRILLS.

After the chief experiment of this series had been planted it was thought desirable to compare those different forms of seed with the similar ones, but more finely divided and planted thicker in the row. Accordingly the seed prepared for plats B 15 and 16 was reserved for the one-half of each, and for the other half whole and half tubers were cut in thirds and planted in rows respectively adjacent to the whole and half tubers, and three, two and one-eye cuttings were prepared, of which three times as many were required for the same weight as in the lots with which they were compared. As in all these trials the first lots were planted at intervals of two feet in the row, while in this finer series the pieces were planted only eight inches apart.

The results, as shown in the table below, are in every case in favor of drills. This is shown in rate per acre in the right hand column. But it must be borne in mind that these rates are for small areas, and in order to raise their yields to acre proportions the differences have to be multiplied fifty times. But if on repetition on a fairly large scale these differences are maintained, there will be reason to recommend planting much nearer in the row than has been done in case of most of our experiments this year.

	B 15.		B 16.		BOTH PLATS.					BUSHELS PER ACRE IN FAVOR OF DRILLS.	
	Merchant-able.	Small.	Merchant-able.	Small.	Merchant-able.	Merchant-able.	Small.	Small.	Total.	Merchant-able.	Total.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	*Bush.	Lbs.	*Bush.	*Bush.		
Fifteen pounds, whole tubers	78.38	2.75	59.83	8.63	138.21	115.18	11.38	9.48	124.7	......	......
Same weight, tubers cut in thirds	86.49	6.53	83.81	6.05	170.30	141.92	12.58	10.48	152.4	29.74	27.7
Seven and a half pounds, half tubers	58.0	2.63	51.25	6.44	109.25	91.04	9.07	7.56	98.6	......	......
Seven and a half pounds, half tubers, cut in thirds	82.26	2.96	67.43	9.63	149.69	141.41	12.59	10.49	151.9	50.37	53.3
Three pounds, three-eye cuttings, two feet apart	43.70	1.89	34.63	7.88	78.33	65.28	3.77	3.14	68.4	......	......
Three pounds, three-eye cuttings, eight inches apart	52.37	4.29	33.96	8.44	86.33	71.94	12.73	10.61	82.5	6.66	14.1
Two pounds, two-eye cuttings, two feet apart	41.38	2.06	30.0	3.06	71.38	59.48	5.12	4.27	63.8	......	......
Two pounds, two-eye cuttings, eight inches apart	45.28	3.45	30.08	6.40	75.36	62.80	9.85	7.88	70.7	3.32	6.9
One pound, one-eye cutting, two feet apart	25.76	.95	17.21	2.38	42.97	35.81	3.33	2.78	38.6	......	......
One pound, one-eye cutting, eight inches apart	28.14	3.61	18.12	4.42	46.26	38.55	8.03	6.69	45.3	2.74	6.7
Total	541.76	31.12	426.31	63.33	......	......	......	......	......	......	......

* Bushels per acre.

3. WHOLE TUBERS *vs.* CUTTINGS, EQUAL WEIGHT OF SEED.

A small area, left after the general planting was done, was planted June eighteenth to potatoes, using two ounces of seed per hill, as per data given in the table below. The growth was rapid and vigorous until checked by disease early in August. This determined the yield. The tubers were left in the ground until October, nineteenth.

The advantage in this trial is with the half tubers considered alone but if one-fourth the sum of the yields from the cuttings be compared with the yield from the whole tubers there is practically no net difference in favor of cutting the tubers for seed and the labor would be simply thrown away.

Last year in an experiment covering 1.2 acres the difference between whole tubers and cuttings of equal weight was so small that the conclusion was "little or nothing is gained by using cut potatoes for seed, while the labor of cutting and the greater market value of the larger tuber (used) may constitute a positive loss." *

B. GORE—METHOD OF SEEDING.	Number of hills planted.	Number of hills harvested.	Merchantable tubers harvested.	Merchantable size, but decayed.	Small tubers.	Total crop harvested.	CALCULATED TO 100 HILLS.	
							Merchantable tubers.	Total tubers.
			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Whole tubers, 2 oz. per hill	102	102	41.94	5.38	13.94	61.26	41.12	60.06
One-half tubers, 2 oz. per hill.	102	101	51.75	9.25	8.38	69.38	51.25	68.69
Three eye cuttings, 2 oz. per hill	104	95	37.88	5.06	7.69	50.63	39.87	53.29
Two eye cuttings, 2 oz. per hill.	103	88	36.56	7.13	9.94	53.63	41.32	60.94
One eye cuttings, 2 oz. per hill.	103	94	34.81	10.38	7.50	52.69	35.96	56.05

LARGE *vs.* SMALL TUBERS FOR SEED AND THE SAME WITH THE "SEED" ENDS REMOVED.

Eight of the ten rows on Plat F thirteen were used for a small trial under this head. The whole tubers averaged 4.6 ounces each, but when the "seed" ends were removed the weight was reduced to a little under four ounces. The small tubers averaged

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* Report New York Agricultural Experiment Station, 1888, pp. 162–5.

Number of row.		Seed used per row.	Merchantable tubers.	Merchantable size, but decayed.	Small tubers.	Total tubers.	DIFFERENCE IN FAVOR OF							
							LARGE SEED.				SMALL SEED.			
							Merch.	Decayed.	Small.	Total.	Merch.	Decayed.	Small.	Total.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.				
1.....	Large tubers	9½	48.13	8.41	2.88	59.42	......	......	......	......	......	......	......	......
5.....		9½	42.44	11.00	1.81	55.25	40.14	14.31	2.46	56.91	......	......	......	......
2.....	Same, seed ends removed	8	44.69	7.80	1.94	54.43	......	......	......	......	......	......	......	......
6.....		8	43.48	6.13	2.13	51.74	Difference in favor of whole tubers.				......	......	......	......
3.....	Small tubers............................	4½	35.75	5.31	3.94	45.00					Tub'rs with seed ends remov'd			
7.....		4½	39.48	3.95	.28	43.71	2.40	5.48	.62	8.50	......	......	......	......
4.....	Small tubers, seed ends removed.......	4	29.09	1.19	1.08	31.36	......	......	......	......	......	......	......	......
8.....		4	34.28	8.58	1.00	43.86	11.86	......	2.14	13.49	......	.51	......	......

2.2 ounces and when the "seed" ends were removed, under two ounces. These were planted thus: a row of large tubers whole, then a row of the same with the seed ends removed, followed by small tubers in the third row, and in the fourth the small tubers with seed ends removed.

The next four rows were a repetition of the first set of four.

There were no missing hills at harvest, hence the amounts given in the table were actually harvested.

On comparing the four rows with large seed with the four where small tubers were used for seed, the differences in favor of the heavier seeding amounts to over thirty-three bushels per acre for fifteen bushels of seed and the extra labor of putting in the seed and harvesting one load more of crop. If seed and crop were both fifty cents per bushel, this increased pay for labor would amount to nine dollars, with the possibility of fifteen dollars, should there be no decayed tubers per acre.

Comparing the yields between whole and cut tubers, four extra bushels of seed in whole tubers produced about ten bushels more merchantable crop, which, at the same prices, would pay for seed and leave three dollars for handling the extra crop without the labor of cutting seed.

COMPARATIVE PRODUCTIVENESS OF TUBERS.

(*a.*) *Selected from general crop,* 100 *tubers of equal weight.*— In order to get some result which would be of value in making selections or serve as a pointer in making selections of seed tubers to avoid the running out of varieties, 100 tubers of equal weight were selected and planted as nearly under like conditions as possible. The plat devoted to this trial was several times severely washed by surface water and when harvested only twenty hills could be fairly compared because of the number of decayed tubers in all the other hills.

The yields ranged from three tubers weighing ten ounces to ten tubers weighing forty-six ounces, and averaged 10.3 tubers weighing twenty-eight and one-quarter ounces. The nearest yields to average were four at twenty-eight ounces and one each at twenty-seven and twenty-nine ounces.

(*b.*) *Best tubers selected from best hills.*— Planted on same plat with above fifty tubers from most productive hills of 1888 which were fairly even in size and which weighed seven and one-half pounds. Only ten hills were free from decayed tubers so comparative weights could be taken. They are given below.

(*c.*) *Best selected from poorest hills.*— From this selection fifty tubers of a weight equal to the above fifty were planted on the same plat. Of the fifty hills fourteen contained all sound tubers and are given below.

(*d.*) *Selected from general stock.*— This was a selection of seven and one-half pounds comprising fifty tubers to compare with the above selection.

(*e.*) *Selected from general stock.*— This was another selection of fifty tubers but of a larger size weighing eleven and one-half pounds, also for comparison with above.

(*f.*) *From selection "b."*— The ten very largest tubers weight four and seven-eighths pounds.

(*g.*) *From selection "b."*— The ten second largest tubers weight three and one-thirty-seconds pounds.

(*h.*) *From selection "b."*— Six tubers very much branched.

For convenience in tabulating the above are denoted by letters in the table. The yield from the branched or pronged tubers were all smooth.

In view of the abnormal conditions to which this plat was subjected no discussion is made, but the results have been tabulated as a matter of record.

NUMBER OF HILLS.	A.		B.		C.		D.		E.		F.	G.	H.
	Number of tubers per hill.	Weight of tubers.	Number of tubers per hill.	Weight of tubers.	Number of tubers per hill.	Weight of tubers.	Number of tubers per hill.	Weight of tubers per hill.	Number of tubers per hill.	Weight of tubers per hill.	Ten largest smooth tubers from most productive hills.	Ten second largest smooth tubers from most productive hills.	Six tubers very much branched.
		Ozs.		Ozs.		Ozs.		Ozs.		Ozs.			
1	3	10	3	30	9	25	4	13	9	25	......	....	.....
2	8	21	5	21	9	18	7	32	9	23	......	....	.....
3	14	27	9	29	9	16	6	26	5	27	......	....	.....
4	8	24	5	15	11	34	7	26	11	25	......	....	.....
5	13	26	5	22	12	34	4	24	10	36	......	....	.....
6	12	34	4	29	8	30	7	18	8	20	......	....	.....
7	14	13	3	12	5	22	12	30	6	25	......	....	.....
8	8	22	7	26	5	23	....	....	7	44	......	....	.....
9	10	41	6	20	8	21	....	....	5	21	......	....	.....
10	13	32	....	......	9	20	....	....	5	20	......	....	.....
11	16	38	....	......	8	26	....	....	6	26	......	....	.....
12	12	36	....	......	7	26	....	....	10	27	......	....	.....
13	11	30	....	......	7	26	....	....	....	......	......	....	.....
14	10	24	....	......	8	40	....	....	....	......	......	....	.....
15	10	46	....	......	....	....	....	....	....	......	......	....	.....
16	11	28	....	......	....	....	....	....	....	......	......	....	.....
17	6	28	....	......	....	....	....	....	....	......	......	....	.....
18	13	28	....	......	....	....	....	....	....	......	......	....	.....
19	9	28	....	......	....	....	....	....	....	......	......	....	.....
20	5	29	....	......	....	....	....	....	....	......	......	....	.....
Merchantable (lbs. and ozs.)	206	565	52	224	....	361	....	169	....	319	......	....	.....
Small (lbs. and ozs.)	....	113-14	....	47-4	....	46-3	....	45-7	....	49-2	10-5	8-7	9-4
	....	9-4	....	......	....	2-2	....	7-4	....	11-10	-6	1-0	-6

RELATIVE YIELDS FROM EYES REMOVED AND NOT REMOVED FROM THE SEED TUBER.

Which eye of a potato will vegetate first? And which, if any one, is most prolific? Also, how does each individual eye, when removed by cutting to the center, compare in vigor, as shown by early germination and in prolificacy, with an eye correspondingly distant numerically from the stem, but not removed from the tuber — all other eyes on the tuber being destroyed?

Two rows of thirty-three hills each were used to make a trial of this in a small way. Thirty-six tubers of equal weight, and each bearing eleven eyes, were selected, and three were planted in one row by cutting and planting, first, the eye nearest the stem; second, the next nearest eye, etc., and using the second and third tubers in the same way after the first had been planted. In the second row was planted a whole tuber, except that every eye was carefully destroyed, save the one corresponding in position on the tuber to the single eye planted opposite to it in the other row.

That is, beginning at the same end as in planting the first row, the eye nearest the stem was saved and planted in the first hill, the second in the next hill, and so on, beginning back at the stem, after the eleventh and twenty-second hills had been planted.

The weight of seed was three tubers, seven ounces, and of the thirty-three tubers, four and three-fourths pounds. Care was taken to note, by daily observation, when each hill developed a green shoot at the surface. This is called the date of vegetation.

Every one of the thirty-three eyes germinated in each case, as will be noted in the accompanying table, but those removed from the tuber were later by three days on an average than those which were planted with the tubers.

That these belated plants were weakened was shown by the difference in development of tops, but more positively in the yields of tubers which are given below in Table II.

It will be observed from the table appended that four of the hills from removed eyes failed to produce a crop. These were two first eyes, one eighth and one eleventh. From the twenty-nine eyes which produced crop, seventy-nine tubers weighing fourteen pounds and one and one-quarter ounces were harvested.

Of the thirty-three eyes planted which were not removed from the tubers, thirty-two produced crop and only one (an eleventh) failed. These thirty-two eyes produced 173 tubers, weighing forty-seven pounds and fourteen ounces. The rate of increase was nearly twenty-three fold against nearly thirty-seven fold for the finely divided seed. Similar results are noted in Station Report for 1885, page 210. But considering the yields from the areas covered, the eyes not removed produced more than three times as much as those removed.

There is too little data on which to base a general statement, even if the point were clear in regard to which eye will vegetate first or which is most prolific. There seems to be a preponderance of early vegetating eyes in a middle zone in both series, but it is not prominent.

As regards prolificacy so small a number of trials could hardly be expected to show any decisive results. The chief point of interest in this last connection is the harmony with the results of a nearly similar trial in 1885* where the larger amount of seed planted apparently influenced the yield, but in that case the terminal eyes seem to have been rather more prolific than the basal ones, a relation which it is impossible to trace in this data.

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* See Station Report for 1885, pages 209–210.

TABLE I.

Number of eye.	REMOVED EYES.							EYES NOT REMOVED.						
	Average date.	Date of vegetation.	Merch. tubers.	Decayed tubers.	Small tubers.	TOTAL HARVESTED.		Average date.	Date of vegetation.	Merch. tubers.	Decayed tubers.	Small tubers.	TOTAL HARVESTED.	
						Number of tubers.	Weight.						Number of tubers.	Weight.
			Lbs. ozs.	Lbs. ozs.	Lbs. ozs.		Lbs. ozs.			Lbs. ozs.	Lbs. ozs.	Lbs. ozs.		Lbs. ozs.
1...	....	May 27.....	....	....	....	....	....	....	May 30.....	0-8	0-2½	0-1	....	0-11½
2...	....	June 12.....	....	....	0-4	3	0-4	....	May 22.....	0-10¾	0-3¾	0-3¾	....	1-2¼
3...	....	May 30.....	....	....	0-2	2	0-2	....	May 27.....	1-4¾	0-8¾	....	....	1-13½
4...	....	May 27.....	0-12½	0-5¾	....	5	1-2¼	....	May 25.....	1-15	....	....	9	1-15
5...	....	May 25.....	0-12	....	....	2	0-12	....	June 11.....	0-15	....	0-3	6	1-2
6...	....	June 3.....	0-10½	....	....	3	0-10½	....	May 23.....	2-6	....	0-2¼	11	2-8¼
7...	....	May 21.....	1-5	....	0-1¾	4	1-6¾	....	May 21.....	1-13	0-6¼	0-0¼	6	2-3½
8. .	....	May 27.....	0-15¼	....	....	2	0-15¼	....	May 23.....	2-10¼	....	0-1½	4	2-11¾
9...	....	June 10.....	0-9	....	....	2	0-9	....	May 23.....	0-13	0-2¼	....	4	0-15¼
10...	....	May 21.....	....	....	0-2¼	2	0-2¼	....	May 27.....	1-12	....	....	7	1-12
11...	May 29.	May 25.....	0-7	....	....	2	0-7	May 26.	May 25.....	1-9	....	....	6	1-9
1...	....	May 23.....	....	....	0-1¾	1	0-1¾	....	May 27.....	1-7½	....	....	6	1-7½
2...	....	May 23.....	....	....	0-4	2	0-4	....	June 10.....	1-0¾	0-2½	0-2¾	8	1-6
3...	....	June 10.....	0-4¼	....	....	1	0-4¼	....	May 23.....	1-15½	0-5	....	5	2-4½
4...	....	June 10.....	0-6¼	....	....	3	0-6¼	....	May 25.....	1-6	....	....	5	1-6
5...	....	June 10.....	....	....	0-1¾	2	0-1¾	....	May 30.....	0-8	0-8½	0-2¾	7	1-3¼
6...	....	June 15.....	....	....	0-6	6	0-6	....	May 21.....	0-8	....	0-10	14	1-2
7...	....	May 21.....	....	....	0-1	1	0-1	....	May 21.....	....	1-11¾	0-3	3	1-14¾
8...	....	May 21.....	....	....	0-2¼	2	0-2¼	....	May 28.....	0-12	0-6	0-2	6	1-4
9...	....	June 14.....	....	0-1	0-1¼	2	0-2¼	....	May 25.....	0-10¼	1-1	....	5	1-11¼
10...	....	June 3.....	0-5	....	0-2	2	0-7	....	May 25.....	1-12¼	....	....	8	1-12½
11...	June 2..	May 30.....	0-15	....	....	2	0-15	May 26.	May 21.....	1-6	0-5½	....	5	1-11½
1...	....	May 24.....	....	....	....	....	0-	....	June 5.....	2-6¾	....	....	8	2-6¾
2 ..	....	May 23.....	0-8¼	....	0-3	5	0-11¼	....	June 3.....	0-9½	1-13½	....	4	1-7
3...	....	May 21.....	0-11	....	0-2	4	0-13	....	May 27.....	0-15¾	0-6¾	....	5	1-6½
4...	....	May 27.....	0-11¼	....	....	2	0-11¼	....	May 28.....	0-7	0-6½	....	2	0-13½
5...	....	May 21.....	0-13	....	0-1	4	0-14	....	June 3.....	1-8¼	....	....	5	1-8¼
6...	....	June 3.....	....	....	0-1½	1	0-1½	....	May 23.....	0-10	0-8	....	4	1-2
7.	....	May 25.....	....	....	0-3	2	0-3	....	May 21.....	1-0½	0-5¼	....	7	1-5¾
8...	....	May 25.....	....	....	....	....	....	....	May 23.....	0-5½	0-12¾	....	4	1-2¼
9...	....	May 25.....	0-8	....	0-1¾	6	0-9¾	....	May 25.....	....	....	0-8½	6	0-8½
10...	....	May 27.....	0-3	0-3	0-1	4	0-7	....	May 21.....	....	....	....	0	....
11...	May 26.	June 3.....	....	....	....	....	....	May 26.	May 21.....	....	0-2	0-4¼	3	0-6¼

TABLE II.

	YIELD FROM										
	First eye.	Second eye.	Third eye.	Fourth eye.	Fifth eye.	Sixth eye.	Seventh eye.	Eighth eye.	Ninth eye.	Tenth eye.	Eleventh eye.
Eyes removed	....	0- 4	0- 2	1- 2¼	0-12	0-10¼	1- 6¾	15¼	9	2¼	7
Eyes removed	0- 1¾	0- 4	0- 4¼	0- 6¼	0- 1¾	0- 6	0- 1	0- 2¼	0- 2¼	0- 7	0-15
Eyes removed	....	0-11¼	0-13	0-11¼	0-14	0- 1½	0- 3	... .	0- 9¾	0- 7	....
Totals	0- 1¾	1- 3¼	1- 3¼	2- 3¾	1-11¾	1- 1¾	1-10¾	1- 1½	1- 5	1- 0¼	1- 6
Eyes not removed	0-11½	1- 2¼	1-13½	1-15	1- 2	2- 8¼	2- 3½	2-11¾	0-15¼	1-12	1- 9
Eyes not removed	1- 7½	1- 6	2- 4½	1- 6	1- 3¼	1- 2	1-14¾	1- 4	1-11¼	1-12½	1-11½
Eyes not removed	2- 6¾	1- 7	1- 6½	0-13½	1- 8¼	1- 2	1- 5¾	1- 2¼	0- 8½	....	0- 6¼
Totals	3-14¾	3-15¼	5- 8½	4- 2½	3-13½	4-12¼	5- 8	5- 2	3- 3	3- 8½	3-10¾

SEED PLANTED ON SURFACE OR IN FURROW.

On two one-tenth acre plats on which the seed was whole tubers, halves, three, two and one-eye cuttings, the two rows with each form of seed were planted adjacent to each other and in the odd numbered rows the seed was dropped on the surface and covered with a hoe to about the same depth that the even numbered rows were covered in furrows. All received the same treatment afterward, and when hilled up, as they all were slightly at the last hoeing, no one could detect any difference in the pairs of rows. No difference was discernable in the growth or appearance of tops between the pairs of rows, but as between one pair and another there was great difference as noted under methods of seeding.

The record shows that the casualties were only two-thirds as great for the small seed when planted on the surface as when buried in a furrow, but that when missing hills are added into the result at the average rate of those actually harvested the yield was a little more from furrows than from an equal amount of seed planted on the surface. This difference, however, is very small and is far within the possibilities of duplication of plats. When increased to acre proportions it is only four and one-half bushels, not enough to cause anyone to depart from his custom in planting if that has been on the surface.

	PLANTED ON SURFACE.					PLANTED IN FURROW.					DIFFERENCE IN FAVOR OF:			
											SURFACE PLANTED.		FURROW PLANTED.	
	Number of missing hills.	Merchantable.	Small.	Decayed.	Total.	Number of missing hills.	Merchantable.	Small.	Decayed.	Total.	Merchantable.	Total.	Merchantable.	Total.
											Lbs.	Lbs.	Lbs.	Lbs.
Whole tubers, B 13	0	60.56	12.38	2.75	75.69	0	69.81	12.25	2.50	84.56	......	......	9.25	8.87
Whole tubers, B 14	0	57.81	8.75	11.25	77.81	0	75.19	?	2.56	......	17.38	......	......	....
Half tubers, B 13	3	31.10	10.19	3.72	45.01	0	58.31	4.31	.75	63.37	......	......	27.20	18.36
Half tubers, B 14	3	41.62	5.62	2.16	49.40	0	49.69	1.88	0	51.57	......	......	8.07	2.17
Three-eye cutting, B 13	3	22.28	5.49	4.0	31.77	1	20 18	3.05	.13	23.36	2.10	8.41	......	....
Three-eye cutting, B 14	3	25.74	3.40	0	29.14	1	29.07	2.28	.13	31.48	......	......	3.33	2.34
Two-eye cutting, B 13	4	15.94	2.58	1.02	19.54	7	12.58	1.12	1.26	14.96	3.36	5.18	......	....
Two-eye cutting, B 14	4	23.40	2.59	.46	26.45	6	25.10	2.34	0	27.44	......	......	1.70	.99
One-eye cutting, B 13	10	6.33	3.39	1.18	10.90	25	5.03	.80	1.72	8.55	1.30	2.35	......	....
One-eye cutting, B 14	10	13.26	1.84	3.54	18.64	21	14.85	1.74	1.65	18.24	......	.40	1.59	....
Total difference in favor of surface planting											24.14	16.34+	——	——
Total difference in favor of planting in furrow											......	......	51.14	32.73
Net difference in favor of planting in furrow											......	......	27.0	16.39—

FERTILIZER EXPERIMENTS WITH POTATOES.

WHICH ELEMENT IS DOMINANT FOR POTATOES?

In 1888 a series of experiments were attempted with a view to gaining some further information on the question, which fertilizing element is dominant for potatoes. It is well-known that potato tubers contain a large amount of potash (59.8* per cent of the ash), hence the practice which largely prevails of supplying a potash dressing for this crop, but it has been believed by some that in the presence of available nitrogen, potatoes were able to gather the requisite potash even from soil poor in that element, or in which it exists in a state of great dilution.

This trial was planned to supply to five plats a sufficient amount of phosphoric acid and nitrogen for a full crop, and, perhaps, more than the crop could use to advantage, in order that there could be no check in growth due to a lack of either of these elements, where different amounts, different forms, or no potash at all, was under trial. To each of five adjacent plats, phosphoric acid and potash were applied in amounts sufficient for the needs of a full crop, and nitrogen in different amounts and forms was applied to four, while one was left with no application of nitrogen.

The plats to which these applications were made, were used for row comparisons of different amounts of seed, and by an oversight the comparisons were not arranged so an equal amount of seed was planted on each plat. This so disturbed the results that nothing could be done with the data that season, for the yields were in harmony with the amounts of seed planted per plat, and, although there were differences, one could not say they were due to fertilizer.

This season, part of the plats having been used for other purposes, but this experiment has been continued on the remaining fifteen, and the same amounts of fertilizing elements reapplied to the same plats as received them last year, hence, whatever there may be of cumulative value from that fertilizing, will be present to help this year's results.

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* How Crops Grow (Eng. ed.), p. 374.

In the six years previous to 1888, or since plowed up from old turf, the B plats, refertilized this season, received the following amounts of fertilizers:

	Pounds per acre.
B 8	2,000
B 9	2,800
B 10	1,200
B 11	1,600
B 12	1,600

The crops have been quite various, but on examining the record of fertilizing, it is found that the differences in the above table were all made the first year, 1882, and by the omission of fertilizer on plat 11 in 1884. No fertilizer was applied in either 1883 or 1887, and all received 400 pounds per acre, in each of the years 1884, 1885, 1886, with above single exception.

The F plats included in this experiment were plowed for the first time in some years in 1884. In that year, Nos. 3, 4, 5 and 6 received at the rate of 400 pounds per acre of commercial fertilizer, and the others, except No. 11, which received nothing, a dressing barn-yard manure. In 1885 barn-yard manure was applied to Nos. 3 and 4, and nothing to the other plats. All received at the rate of 400 pounds of acid phosphate per acre in 1886, and no fertilizer was applied in 1887. Fertilizers were applied in 1888 in like amounts of the same formulas as given below, except that the potash was only half the strength of what was used in 1889, and consequently double the given amounts were used.

Influence of the season. — The past season must be regarded as favorable to the growth of the potato plant and the development of the tubers. But the large amount of moisture present so much of the time was very favorable to the growth of fungi, one species of which, commonly known as "the potato rot" (*Phytophthora infestans, DeB.*), has been very harmful to the crop. This had more influence on the A than on the F plats, which were much nearer maturity before the disease appeared.

Some of the F plats have produced a crop of potatoes for three years previous to this season. In making a critical examination of the crop from these plats last year, it was remarked that "an effect of season which is enough to reduce the yield as much as is shown below could hide, or so obscure results of fertilizing as to completely change the normal effect under favorable circumstances. This effect of season may be seen by the general average of yield from these plats, for the two previous years as compared with this year."

The table given with above has been changed to show the average yields of merchantable tubers from those plats on which the seeding was alike, for the two years 1886–7, without regard to seeding in 1888, and with mixed seeding but the same for each plat in 1889.

Plat.	Year.	FERTILIZER PER ACRE.	YIELDS PER ACRE.	
			Merchantable.	Total.
F 7-10	1886.......	Four hundred pounds acid phosphates......	90.7	102.3
F 7-10	1887.......	No fertilizer	155.4	165.4
F 7-10	1888.......	Mixed fertilizer (see table below)............	89.9	104.3
F 7-10	1889.......	Mixed fertilizer (see table below)............	119.1	131.0

This shows that notwithstanding the plats were liberally fertilized in 1888 the yield was low, but that for the past season it was above the average, yet far below the favorable season of 1887, when no fertilizers were applied.

Notes taken on July twenty-ninth indicate that as between plat 3 and 4 F there was no apparent difference in growth or color of tops. Where whole or half tubers were planted the growth of tops was ranker than from "finer cut seed." This has been the remarkable characteristic all the season, as it has on all the other plats where compared. Plat F 5, growth of tops rather smaller than on 3 and 4, but darker green. Plat 6 has made rather larger growth of tops than plat 7, and seems also to be nearer maturity, while No. 7 has a rather darker color, being about a medium between the color of 5 and 6. Plat No. 6 has distinctly the lightest colored foliage. Plat F 8 very like 7 in growth and color. Plat 9, growth of tops smaller than on 7 and 8, and a trifle lighter colored. Less growth of tops on Plat 10 than on 9. Plats 11 and 12 about alike, and like F 3 and 4 but rather heavier. 13 (no fertilizer), heavy growth of tops of medium color. 14 (no fertilizer), good growth of tops but rather irregular. Shows result of water coursing diagonally across the plat.

The following table shows the fertilizers applied and crop produced calculated to supply the missing hills, which were mainly from those rows where the seed was finely divided:

Plat.	FERTILIZER.	Amount used.	Amount per acre.	Merchantable tubers per plat.	Total tubers per plat.	Merchantable tubers per acre.	Total tubers per acre.
				Lbs.	Lbs.	Bush.	Bush.
F3...	Dis. bone black Ammonium sulphate Potassium chloride	20 20 20	400 400 400	414.48	460.99	138.2	153.7
F4...	Dis. bone black Ammonium sulphate Potassium sulphate	20 20 *15	400 400 300	369.71	405.21	123.2	135.0
F5...	Dis. bone black Ammonium sulphate	20 20	400 400	256.61	308.16	85.5	102.7
F6...	Dis. bone black Ammonium sulphate Potassium chloride	20 20 30	400 400 600	395.37	433.50	131.8	144.5
F7...	Dis. bone black Ammonium sulphate Potassium sulphate	†20 20 ‡22.5	400 400 450	305.14	334.97	101.7	111.6
F8...	Dis. bone black Potassium sulphate Sodium nitrate	20 15 25	400 300 500	353.81	394.46	117.9	131.5
F9...	Dis. bone black Potassium sulphate Ammonium sulphate	20 15 20	400 300 400	418.49	464.45	139.5	154.8
F10..	Dis. bone black Potassium sulphate	20 15	400 300	351.17	377.99	117.1	126.0
F11..	Dis. bone black Potassium sulphate Sodium nitrate	20 15 12.5	400 300 250	326.56	347.95	108.9	116.0
F12..	Dis. bone black Potassium sulphate Ammonium sulphate	20 15 10	400 300 200	343.40	365.72	114.5	121.9
B8 ..	Dis. bone black Potassium sulphate Sodium nitrate	20 15 25	400 300 500	490.38	569.95	81.7	95.0
B9 ..	Dis. bone black Potassium sulphate Ammonium sulphate	20 15 20	400 300 400	484.65	550.17	80.8	91.7
B10..	Dis. bone black Potassium sulphate	20 15	400 300	424.22	468.05	70.7	78.0
B11..	Dis. bone black Potassium sulphate Sodium nitrate	20 15 12.5	400 300 250	487.90	530.50	81.3	88.4
B12..	Dis. bone black Potassium sulphate Ammonium sulphate	20 30 10	400 600 200	482.29	510.88	80.8	85.6

* Whenever P. sulphate is given in this table, the application was of sixty per cent while that used in 1888 was only thirty per cent.

† Dis. B. B., only nineteen pounds in 1888, owing to failure of supply.

‡ P. sulphate only seventeen pounds in 1888, owing to failure of supply.

With like conditions and treatment throughout the season, save this one of fertilizing, the plats may be expected to show the value of the fertilizer. In case of these plats, we have whatever of value there may be in the cumulative effect of the same application to the same crop. This must be considerable in case of the potash, but may be next to nothing for nitrogen, which is supposed to be pretty thoroughly eliminated during the winter season. In this connection it may be well to remark that for the past two seasons the rainfall has been far above the average, and that the plats have been severely washed by heavy rains several times the past season. Making comparisons of the crops from above plats, by groups as fertilized, we find that there has been a much higher yield from the plats which received potassium chloride with the supply of nitrogen and phosphoric acid, than from the one receiving no potash, and that the plats on which potassium sulphate was used gave a nearly intermediate yield. This is significant that the custom of dressing land with potash for potatoes is well founded. It is to be regretted that the duplicate fertilizing on the B plats could not have been repeated. Making similar comparisons on the plats on which nitrogen was on trial, we find a much less marked, but yet a considerable increase of crop over the plat which received no nitrogen from both forms of nitrogen used, and nearer even in

YIELDS PER ACRE — F PLATS.

	MERCHANTABLE TUBERS.		
	Potassium chloride.	No potash.	Potassium sulphate.
	138.2	85.5	123.2
	131.8	....	101.7
Average	135.0	85.5	112.5

YIELDS PER ACRE — F PLATS.

	SODIUM NITRATE.		NO NITROGEN.		AMMONIUM SULPHATE.	
	Merch.	Total.	Merch.	Total.	Merch.	Total.
	117.9	131.5	117.1	126.0	139.5	154.8
	108.9	116.0	......	......	114.5	121.9
Average......................	113.4	123.8	117.1	126.0	127.0	138.4
B PLATS.						
	81.7	95.0	70.7	78.0	80.8	91.4
	81.3	88.4	......	......	80.8	85.6
Average	81.5	91.7	70.7	78.0	80.8	88.5

yield between these two forms from the B plats than could have been hoped from duplicates. Indeed, the plats to which different amounts of each of the nitrogen salts were applied have produced remarkably even yields of tubers. This indicates either that the smallest amount applied was sufficient for the crop, or that neither was potential in producing the increase over the yield of the plat which received no nitrogen. From the F plats there were variable results. One only on which nitrogen was applied as ammonium sulphate, at the rate of 400 pounds per acre, produced more crop than that to which no nitrogen was given, while one gave practically the same, and two less. On the whole there was a gain on the ammonium sulphate plats, which may be regarded as due to the application on plat 9.

Another point of interest in this connection is the influence of potash on potato rot.

The action of potash in preserving the tops from rot on a soil rather poor in potash, has been noted the past season at the Kentucky Experiment Station.* We have here to show on a soil which may be called rich in potash, an apparently opposite effect on the tubers, though this may not be caused by the salts, but by moisture without relation to, or in spite of the presence of potash.

The five F plats, 3 to 7, were dressed with phosphoric acid, in bone, black and ammonium sulphate, as given in the table above, and four with potash salts, as shown below. The plats F, 8 to 12, all received potash as sulphate, as given in the table above.

Weight of decayed tubers of merchantable size on F plats with:

	Potassium chloride.	No potash.	Potassium sulphate.	Sodium nitrate.	No nitrogen.	Ammonium sulphate.
	Lbs.	Lbs.	Lbs.			
Plats...........	F 3 12.69	F 5 2.03	F 4 15.71	F 8 20.46	F 10 32.66	F 9 13.02
Plats...........	F 6 27.90	....	F 7 45.71	F 11 36.21	....	F 12 56.01
Average	20.3	2.03	30.7	28.34	32.66	34.7

On F plats entirely without fertilizer, planted with same variety of potato, but different form and amount of seed, F 13 yielded 70.41 pounds decayed tubers, and on plat F 14, lying in the course of surface drainage water, the decayed tubers were so far consumed that no weights of them were taken.

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*Director M. A. Scovell, in proceedings S. P. A. S., Toronto meeting, 1889.

On the five B plats, with dissolved bone black and potassium sulphate applied in equal amounts, and nitrogen as follows, the decayed tubers were as here given in pounds:

	Sodium nitrate.		No nitrogen.		Ammonium sulphate.	
Plats	B 8	16.86	B 10	46.92	B 9	3.63
Plats	B 11	15.00	....		B 12	14.64
Average		15.93		46.92		9.14

The record of F plats would seem to indicate that the potash was potential in rotting the tubers, but on the B plats no such action can be traced. It should, however, be remembered that the same amounts were applied in both series, while the B plats being double the size there was only half as much of the application per acre as on the F plats, which may be the reason (if the rot of F plats was at all due to potash) why there was not the same uniformity in decayed tubers as shown on the latter plats.

The general slope of these plats is very slight, but to the north and east. Number 3 lies on the west, is therefore the highest, and No. 14 the lowest.

It will be noticed that the increase of decayed tubers occurred in association with the slope of the land, and hence may be due to excessive moisture.

FERTILIZER BELOW *vs.* ABOVE THE SEED.

An experiment last year (covering one-fourth acre), on this question, gave no marked difference in favor of either side. It has been repeated on plats B 6 and 7, containing one-tenth acre each. The rows were furrowed with an ordinary seed plow, by passing twice in each: In the odd numbered rows the fertilizer was strewn and covered with soil, then the potatoes planted about three inches deep. In the even numbered rows the potatoes were covered about an inch deep, the fertilizer strewn in the row and the covering completed to about three inches.

The fertilizer used was compounded of:

Twenty-five pounds ammonium sulphate.
Twenty pounds potassium sulphate.
Twenty-five pounds dissolved bone black.
Thirty pounds gypsum (ground Nova Scotia rock).

The whole was carefully mixed together and applied at the rate of 500 pounds per acre, by weighing out an aliquot part for each row.

These plats were planted May eighteenth, and were given the same treatment as the other B plats, being cultivated and hoed at the same times, and slightly hilled up at the last hoeing to cover any tubers which grow near the surface.

The seed planted on these plats was the same as on the other plats B 8 to 14, except that the two rows in which the seed was alike and equal were here adjacent. Thus, in rows one and two whole tubers weighing fifteen pounds per row were the seed used. In the next two rows the seed was half tubers, weighing seven and one-half pounds per row, and in the succeeding three pairs of of rows three-eye, two-eye and one-eye cuttings, weighing respectively three pounds, two pounds and one pound per row, were planted.

As in the above experiments the missing hills at harvest have been supplied by calculation in table below, which shows the effect of location of fertilizer below or above the seed.

KIND OF SEED.	FERTILIZER BELOW.					FERTILIZER ABOVE.					DIFFERENCE IN FAVOR OF			
											FERTILIZER BELOW.		FERTILIZER ABOVE.	
	Number of missing hills.	Merch.	Small.	Decayed.	Total.	Number of missing hills.	Merch.	Small.	Decayed.	Total.	Merch.	Total.	Merch.	Total.
		Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Whole tubers .... B 6	0	65.38	30.78	2.47	98.63	0	80.00	18.19	3.16	101.35	......	......	14.62	2.72
Whole tubers .... B 7	0	96.88	12.38	1.50	110.76	1	83.50	15.23	1.97	100.70	13.38	10.06	......	....
Half tubers .... B 6	2	62.98	7.79	3.35	74.12	0	50.69	16.91	1.81	69.41	12.29	4.71	......	....
Half tubers .... B 7	2	66.26	10.43	.35	76.04	0	70.44	11.78	.63	82.85	......	......	4.18	6.81
Three-eye cuttings................. B 6	4	33.53	5.23	.30	39.06	5	35.50	7.78	.24	43.52	......	......	1.97	4.46
Three-eye cuttings.... .... B 7	5	37.13	4.40	.07	41.60	1	42.01	5.46	0.0	47.47	......	......	4.88	5.87
Two-eye cuttings.................. B 6	6	28.88	6.94	0.0	35.82	12	29.79	2.67	.23	32.69	......	3.13	.91	....
Two-eye cuttings.................. B 7	18	35.11	4.21	.30	39.69	15	34.89	3.80	.49	39.18	.22	.44	......	....
One-eye cuttings.................. B 6	25	19.32	3.22	.85	23.39	43	13.45	2.87	1.72	18.04	5.87	5.35	......	....
One-eye cuttings.................. B 7	29	25.53	2.34	.78	28.65	38	19.74	3.39	0.00	23.13	5.79	5.52	26.56	19.86
Total differences											37.55	29.21		
Net difference in favor of fertilizer below the seed											10.99	9.35		

This difference in one-tenth acre areas is so small that they may be regarded as almost identical and bear out the first experiment in the testimony that it makes no difference whether the fertilizer is above or below the seed.

MUCK *vs.* MANURE ON B 15 AND 16.

These two plats were differently fertilized in 1888 for a comparative trial of muck versus manure, phosphoric acid and potash being added to the one on which muck was applied to equal the calculated difference between those elements in the muck and manure.

This season, instead of making any calculation to supply ash elements, one cord of muck was plowed in on B 15 and one cord of good stable manure on plat 16. The yields from these two plats, shown in the above table, page 235, is in favor of that on which the muck was applied by nearly two bushels of merchantable tubers, and of one bushel and twenty-three pounds on the total crop of sound tubers.

FERTILIZER EXPERIMENT WITH CORN.

This is a continuation of the trial begun last year to test the relative value of the various fertilizing elements for corn, on the same ground continuously, for several years. The comparison is extended to the barn-yard manure and to green manuring, so far as a crop of rye grown after the ripe corn comes off in the fall, and before the spring plowing the following season, will allow.

This season the muck and manure were drawn out and spread March twenty-fifth. The plats were plowed May tenth and eleventh and the furrows harrowed down soon after. They were harrowed, marked and planted on the fifteenth, and rolled with a heavy roller on the sixteenth. The fertilizers were sown on the twenty-first, with exception of manure and muck noted above, and green rye, a very light stand of which was plowed in on the tenth.

SPECIAL FERTILIZERS AND STAND OF CORN.

Plat.	REMARKS.	Sodium nitrate.	Ammonium sulphate.	Potassium sulphate.	Dissolved bone black.	Barnyard manure.	Plaster (gypsum).	Muck.	Soluble Pac. guano.	High Grade Farmer's Friend.	Potassium chloride.	Dissolved South Carolina rock.	Ground South Carolina rock.	Potassium nitrate.	Number of hills.	Number of stalks.
		Lbs.	Lbs.	Lbs.	Lbs.		Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		
C 14	......	480	......	......	......	......	......	......	......	......	......	......	......	......	200	659
C 15	......	......	......	400	......	......	......	......	......	......	......	......	......	......	200	677
C 16	......	......	......	......	400	......	......	......	......	......	......	......	......	......	199	748
C 17	......	......	......	......	......	*	......	......	......	......	......	......	......	......	198	683
C 18	No manure	......	......	......	......	......	......	......	......	......	......	......	......	......	198	662
D 15	......	480	......	400	......	......	......	......	......	......	......	......	......	......	198	839
D 16	......	480	......	......	400	......	......	......	......	......	......	......	......	......	200	795
D 17	......	......	......	400	400	......	......	......	......	......	......	......	......	......	199	717
D 18	No manure	......	......	......	......	......	......	......	......	......	......	......	......	......	199	651
D 19	......	......	......	......	......	†	......	......	......	......	......	......	......	......	199	705
E 15	......	480	......	400	400	......	......	......	......	......	......	......	......	......	198	782
E 16	......	240	......	200	200	......	......	......	......	......	......	......	......	......	198	748
E 17	No manure	......	......	......	......	......	......	......	......	......	......	......	......	......	200	745
E 18	......	......	......	......	......	......	......	......	500	......	......	......	......	......	198	664
E 19	......	......	......	......	......	‡	......	......	......	......	......	......	......	......	200	712
F 17	......	......	......	......	......	......	600	......	......	......	......	......	......	......	198	675
F 18	No manure	......	......	......	......	......	......	......	......	......	......	......	......	......	198	676
F 19 §	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
F 20	......	......	......	......	......	......	......	‖	......	......	......	......	......	......	198	686
F 21	......	......	......	......	......	......	......	......	......	300	......	......	......	......	197	578
G 18	......	......	400	......	......	......	......	......	......	......	......	......	......	......	200	616
G 19	......	......	......	......	......	......	......	......	......	......	400	......	......	......	200	637
G 20	......	......	......	......	......	......	......	......	......	......	......	......	400	......	200	617
G 21	......	......	......	......	......	......	......	......	......	......	......	......	......	400	200	703
G 22	......	......	......	......	......	......	......	......	......	......	......	400	......	......	199	627

* Ten two-horse loads. † Twenty two-horse loads. ‡ Thirty two-horse loads. § Light growth of winter rye plowed in for green manure.
‖ Twenty two-horse loads.

The plats were cultivated both ways and hand hoed June fourteenth. They were cultivated both ways but not hand hoed July thirteenth. Weeds were cleaned out by hand August sixteenth.

Five kernels of Waushakum corn were planted in each hill, and 200 hills per plat. Notwithstanding the corn was not thinned as last year, there was a less and very irregular stand on the whole. Plats D 15, 16, and E 15, were the only ones on which the stand was greater than in 1888, and on only one was it above four stalks per hill. On one plat, F 21, the stand was below three stalks per hill.

September nineteenth the corn was cut and stood in shock until October eight, nine and ten, when it was weighed and husked.

Roaming fowls attacked the corn after it began to ripen and continued pilfering from it until all was removed from the field. In sorting, the pecked ears and cobs, were counted and weighed separately. The ears of "sound" and "soft" corn being counted, and weighed, gave data for supplying, by calculation, the weight of corn lost. These amounts have been included in "total crop," and "sound corn" columns of the following table:

1889 — PLAT.	First vegetation.	First appearance of panicle.	First bloom.	First appearance of glazing.	First ripe seed observed.	Total crop.	Sound corn.	Soft corn.	Pounds stover for 100 pounds sound corn.	Average weight of sound ears.
						Lbs.	Lbs.	Lbs.		Lbs.
C — 14	May 22	July 17	July 26	September 4	September 12	700.6	275.3	12.38	150	.3771
15	May 22	July 17	July 26	September 2	September 12	428.3	190.8	11.75	118	.3407
16	May 22	July 17	July 26	September 2	September 12	496.1	220.4	15.50	118	.3695
17	....	July 15	July 26	September 2	September 12	458.3	202.0	8.00	123	.3712
18	May 23	July 17	July 26	September 4	September 12	442.0	203.3	3.75	116	.3523
D — 15	May 23	July 17	July 26	September 4	September 12	637.0	227.0	11.50	126	.3650
16	May 25	July 17	July 26	September 4	September 12	646.7	281.4	14.75	125	.3914
17	May 23	July 17	July 26	September 2	September 12	474.9	199.9	6.00	135	.3482
18	May 23	July 17	July 26	September 2	September 12	381.1	176.3	8.25	111	.4364
19	May 23	July 17	July 24	September 4	September 12	500.3	227.8	8.75	116	.3722
E — 15	May 27	July 17	July 26	September 4	September 12	656.9	285.1	14.06	126	.3703
16	May 27	July 17	July 26	September 4	September 12	553.3	248.0	14.38	117	.3880
17	May 27	July 17	July 26	September 2	September 12	524.5	247.6	9.75	108	.3833
18	May 24	July 17	July 26	September 4	September 12	433.5	200.2	11.56	111	.3620
19	May 24	July 19	July 29	September 4	September 12	535.5	247.7	10.13	112	.4034
F — 17	May 22	July 22	July 29	September 4	September 12	490.2	220.0	7.56	120	.3559
18	May 23	July 22	July 29	September 4	September 12	363.7	171.4	9.25	107	.3361
19	May 23	July 22	July 29	September 4	September 12	380.2	174.2	12.75	111	.3116
20	May 23	July 22	July 29	September 4	September 12	378.1	179.9	13.00	103	.3368
21	May 25	July 22	July 29	September 4	September 12	406.7	193.9	11.00	104	.3408
G — 18	May 24	July 22	July 29	September 4	September 12	588.1	253.9	20.06	124	.3812
19	May 24	July 22	July 29	September 4	September 12	452.8	193.8	12.25	127	.4222
20	May 22	July 22	July 26	September 4	September 12	447.6	194.8	10.75	124	.3492
21	May 22	July 17	July 26	September 4	September 12	585.0	250.0	10.00	130	.3698
22	May 22	July 22	July 26	September 4	September 12	391.2	192.0	7.00	100	.3416
Average	....	....	....	....	....	494.1	220.3	11.0	119	.3670

Field notes this year, as last, testify to the stockiness and general thrift of plants where nitrogen as nitrate, or sulphate, has been applied. The amounts applied in most cases produced an increase in the ratio of stalks to corn, but had an equal, if not greater effect on the yield of sound corn.

Neither potash nor phosphoric acid have exerted a marked influence on the crop.

The application of plaster has not been followed by any increase of crop above the general average.

Plat F 20, to which muck was applied, has this year fallen back far below the general average.

Nitrogen alone has increased the crop.

Nitrogen with either potash or phosphoric acid has increased the crop.

Nitrogen with both potash and phosphoric acid has increased the crop.

Corn has been selected from each plat for seed on the plat where it grew, in order that the full cumulative effect of the fertilizer may be felt.

CORN IN HILLS, DRILLS AND BROADCAST.

An experiment was undertaken covering eighteen one-twentieth acre plats, to add something to the general fund of knowledge on the question, shall we plant our corn for the crop of ears, for fodder or for the silo, in hills, in drills or broadcast?

It has been pretty well demonstrated that for the best fodder or for ensilage, the plants must be allowed to come to full development and become nearly, if not quite, mature in order to produce the most effective crop. In order to become fully developed, every plant must have a certain amount of room and free access of light and air, large varieties more than small growing ones, but just how much space, depends largely on the condition of soil, environment and the climatic condition of the season.

Our trial has been made with King Philip corn. The characteristics of the season are given very fully elsewhere and may be referred to here as cool, wet, and with only a small percentage of sunshine as compared with the possible.

It will be seen by the table that in each case a definite amount of seed was used, and that when the amount of seed was increased by planting closer in hills and drills, an increase was also made in the amount sown broadcast, so there would be not only a comparison of the three methods of planting corn, but also a comparison of three very different amounts of seed per acre by each method, which varies between giving each plant a large area, to considerable crowding where the most seed was used. This crowding of plants was somewhat interfered with by roaming fowls that picked up some of the broadcast seed which was exposed to view by rain after harrowing in and more by washing away entirely from all three methods of seeding. The C and D plats lie in the course of drainage from a considerable area and were quite severely washed by running water during several of the heavy rains of the season.

This destroys the value of the comparison of different amounts of seed per acre, so the stand of corn on each plat at harvest has been taken and this furnishes data for a comparison which shows the average weight of individual plants grown in each of the three methods of planting.

These plats were planted May seventeenth to eighteenth; hoed first, June fourteenth; hoed second, July thirteenth; weeds were cut out August sixteenth to seventeenth and nineteenth; the crop was harvested September fourteenth.

On July twenty-fourth the appearance of the corn was as follows:

Plats D 5 to 14, inclusive. The corn in hills was about shoulder high, with broad dark-green leaves and just beginning to tassel. In drills it was rather shorter and paler, with nearly as large leaves and slightly in advance of that in "hills," tasseling. That broadcast was smaller than in drills and was comparatively very pale. Weeds were plentiful in the broadcast plats.

Plats C 9 to 13. There seemed to be more difference in favor of "hills" first and "drills" second, as compared with broadcast, except on plats 12 and 13, where the boadcast corn was more open, nearly as tall as in hills and drills, but of a paler color.

Plat G 11. Corn in hills and drills about alike, while that broadcast is poorer.

Plats 12 and 13. Corn in hills has attained a good growth, and has broad dark green leaves. That in drills is about the same and taller than in hills, while that broadcast is not quite so thrifty, but is better than the best on G 11.

At harvest, except for a few scattered stalks, there was very little sound corn on the broadcast plats. On the drilled plats the stalks were fairly eared, while in hills it would have been easy to select considerable corn fit for seed.

COMPARISON OF YIELDS OF CORN PLANTED IN HILLS, DRILLS AND BROADCAST.

PLAT.	HILLS.		DRILLS.		BROADCAST.	
Distance apart	40x48 inches.		40 inches.		....	
Seed used per acre (quarts)	7⅓		10		12	
	Number plants.	Weight.	Number plants.	Weight.	Number plants.	Weight.
		Lbs.		Lbs.		Lbs.
C 9	160	200	154	147	180	110
10	172	266	167	196	184	160
11	168	284	165	224	235	192
12	171	308	146	254	243	240
13	168	319	173	242	202	192
G 11	187	282	152	274	177	164
Totals	1,026	1,659	957	1,337	1,225	1,058
Per cent of full stand	71.24					
Average weight of plants, lbs.	1.68	....	1.40	....	.864	....
Yield per acre	....	16,590	....	13,370	....	10,580
Distance apart	40x36 inches.		24 inches.		....	
Seed used per acre (quarts)	9⅓		13⅓		24	
D 5	206	330	251	248	254	172
6	224	340	197	248	287	176
7	208	164	213	184	275	232
8	222	258	225	198	295	200
9	205	266	222	198	262	154
10	213	248	247	204	306	178
Totals	1,258	1,606	1,355	1,280	1,679	1,112
Per cent of full stand	63.54					
Average weight of plants, lbs.	1.28	....	.95	....	.662	....
Yield per acre	....	16,060	....	12,800	....	11,120
Distance apart	40x24 inches.		16 inches.		....	
Seed used per acre (quarts)	14		20		40	
D 11	329	306	213	204	337	204
12	308	292	253	202	449	254
13	271	274	261	338	405	270
14	306	351	294	220	414	286
G 12	319	298	329	326	380	338
13	307	304	319	316	343	312
Totals	1,840	1,825	1,669	1,606	2,328	1,664
Per cent of full stand	63.19					
Average weight of plants, lbs.	.98	....	.96	....	.715	....
Yield per acre	....	18,250	....	16,060	....	16,640
Average seed per acre (quarts).	10 2-9		14 4-9		25⅓	
Average stand per acre	13,747	....	13,270	....	17,440	....
Average yield per acre	....	16,967	....	14,077	....	12,780
Average weight of plants, lbs.	1.235	....	1,061	....	.733	....

There was in all probability a difference in the water contents of the *crop* from each method of planting, in favor of hills, and against that grown broadcast, which would show the difference in dry matter and food value, to be much greater than that shown in the green crop.

This is more likely, because of the improbability of the less mature corn having lost any of its green weight by ripening, while that in drills and in hills must have lost quite considerable amounts of water from this cause, and gained in dry matter at the same time.

The hills yield most, the drills next, and the broadcast least in case of almost every plat, notably so in the summary. Not only is this the case, but we find the individual weight of stalks most in hills, medium in drills, and least when grown broadcast. The stand of corn as harvested, owing to the unfavorable circumstances of the season, bears no commensurate relation to the amount of seed sown.

Even if we were sure the feeding value of the above crops were equal, pound for pound, the difference in yield is enough to convince the most sceptical that it would have paid on any ordinary farm to have planted that crop in hills. But there is a great probability that there was from five to ten pounds more of dry matter per hundred weight of crop in that grown in hills, over that grown broadcast, and that the corn in drills was nearer to that in hills in this respect than to what was grown broadcast.

This added value in pound for pound, comparison would more than pay the cost of growing the crop, and the excess of crop be net gain over the crop grown broadcast.

SORGHUM IN HILLS AND DRILLS.

On May eighteenth, nine-twentieth acre plats were planted with Early Amber sorghum seed, every alternate row being in drills and the others in hills, three feet apart in the row. The rows were three and one-third feet apart.

No material difference in the development or maturity of plants in hills or drills could be distinguished, except that the unthinned rows contained many more small, as they also did of fully developed ones.

Many of the panicles showed seed in the milk early in September, yet, when allowed to stand until October fifteenth and sixteenth, very little, if any, seed had ripened beyond the thick milk or "dough" stage. This was doubtless due to the excessively cold cloudy weather which prevailed. Very many plants, in both hills and drills, sent up branches from the higher nodes which were either in or near bloom at the time cold weather checked the growth.

The following table shows the stand of plants, harvest weights, and average individual weights of plants in "hills" and in "drills," and by combining these, the thickest and thinnest stand by each method of planting :

COMPARISON OF YIELDS OF SORGHUM PLANTED IN HILLS AND DRILLS.

PLAT.	HILLS.				DRILLS.			
	Stand of crop at harvest.	Weight of crop harvested.	Average weight of plants.	Yield per acre.	Stand of crop at harvest.	Weight of crop harvested.	Average weight of plants.	Yield per acre.
		Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Lbs.
D 1	549	534	.971	21360.	1998	786	.657	31440.
D 2	432	450	1.041	18000.	1201	1008	.839	40320.
D 3	474	488	1.03	19520.	1254	1105	.879	44080.
D 4	536	456	.852	18240.	1209	1100	.9099	44000.
G 10	536	426	.794	17040.	1146	890	.777	35600.
G 14	445	550	1.236	22000.	511	611	1.196	24440.
G 15	448	510	1.138	20400.	743	717	.965	28680.
G 16	545	622	1.1413	24880.	755	813	1.077	32520.
G 17	546	674	1.234	26960.	722	793	1.098	31720.
	4511	4710	1.044	20933.	8739	7820	.895	34755.
Average of five plats unthinned	....	....	....	....	6008	4886	.813	39084.
Average of four plats thinned	....	....	....	....	2731	2934	1.074	29340.
Average of four plats least stand per hill	1799	1998	1.111	19980.	....	....	....	....
Average of five plats largest stand per hill	2712	2712	1.0	21696.	....	....	....	....

On the first five plats shown in the table, there was nearly one plant to every three inches of row in the drills, while in the thinned drills of the last four plats the plants were between five and six inches apart on an average.

The average number of plants per hill was under five on the four plats having least stand in hills, and nearly six on the five plats having largest stand in hills.

The yield in every case increased with the number of plants for a given area, but not in direct proportion, as it will be noticed the average weight of individual plants decreased to a considerable extent.

Missing hills have not been taken into consideration in extending the calculation to yield per acre.

So far as Early Amber sorghum has been tried and allowed to grow to its full stature it has proved to be capable of producing a heavier crop than corn. This is shown in the following table:

	Corn in hills.	Corn in drills.	Sorghum in drills.
	Lbs.	Lbs.	Lbs.
1884:			
Greatest yield per acre	32,595	33,660	45,080
Least yield per acre	......	15,900	24,160
Average yield per acre	......	24,060	35,920
1885:			
Greatest yield per acre	......	54,740	54,820
Least yield per acre	......	30,610	......
Average yield per acre	......	38,558	50,090

TEST VARIETIES OF CORN FOR FODDER IN THIS LOCALITY.

What corn to plant in any given locality in order to produce the most profitable crop, may well become the subject of earnest thought. This, as well as how the crop shall be planted, should be determined, and the seed of the variety decided on should be procured before the hurry of spring's work begins. In general it is advisable to plant only such varieties of corn as are sure to mature before early frost stops growth. A trial on this point for this locality was deemed advisable, and accordingly, seed from various sources, of a number of varieties, was procured and planted in duplicate rows on a strip of ground as even in fertility, and as desirable as could be selected from what was open to use for the experiment. The soil is not particularly rich on any part of the farm, but this field may be regarded as of medium fertility. The whole field was devoted to corn in 1888, and it was then fertilized with thirty loads per acre of stable manure, and the portion not included in the fertilizer trial of that year, was in addition top dressed with 600 pounds of soluble Pacific guano, or about 100 pounds per acre. No very large crop could be expected, but rather a fairly average one. The rows this year extended north and south across the fertilizer plats of 1888, and the portion on which the soluble Pacific guano was applied. A single row of each of the flint corns was planted on the east side of the strip of land used, and the duplicate rows were planted in the same order on the west side. The two rows of each of the dent and sweet corns were planted side by side.

The tables below show the salient points gathered during the season, the crop harvested, per cent of dry matter in same, the yield per acre calculated to perfect stand, and dry matter of same at the rate found in the crop as harvested :

VARIETIES OF CORN — TABLE I.

NAME OF VARIETY.	Seed received from.	Number of rows.	Date planted.	Date vegetated.	Panicle visible.	Silk first observed.	Pollen shedding.	Ear in milk stage.	Ear glazed.	Nodes above ground.	Average number of nodes.	Ear bearing nodes.	Height of stalk, feet.
FLINTS.													
King Philip	Sta.	2	May 6	May 13	July 13	Aug. 5	Aug. 5	Aug. 12	Aug. 23	7-11	8.9	3-4	6.3
Longfellow	Vick	2	May 6	May 12	July 13	Aug. 5	Aug. 5	Aug. 12	Aug. 23	6-10	.8.5	3-5	6.2
Pride of Dakota	Will	2	May 6	May 14	July 13	July 13	July 13	Aug. 5	Aug. 12	......	6.3	......	4.2
Waushakum	Sta.	2	May 6	May 13	July 13	Aug. 5	Aug. 5	Aug. 12	Aug. 23	6-10	8.5	2-5	6.6
Thoroughbred White	Thorb	2	May 6	May 14	Aug. 5	Aug. 5	Aug. 5	Aug. 28	Sept. 16	9-13	10.7	4-7	8.2
Yellow (Longfellow ?)	H. Smith	2	May 6	May 12	July 13	July 17	Aug. 5	Aug. 5-12.	Aug. 23	6-10	8.3	......	6.5
DENTS.													
Blount's Prolific	Vick	2	May 6	May 13	Aug. 5	Aug. 12	Aug. 23	Sep. 16-27.	....	......	......	......	.....
Champion White Pearl	Vick	1	May 6	May 13	Aug. 5	Aug. 5	Aug. 5	Aug. 23	Sept. 16	8-18	14.4	6-13	8.8
Champion Early White Pearl	U. S. Dep. Ag.	1	May 6	May 13	Aug. 5	Aug. 5	Aug. 5	Aug. 23	Sept. 16	......	......	......	.....
Suffern's Champion White Pearl	Suffern	1	May 6	May 13	Aug. 5	Aug. 5	Aug. 5	Aug. 23	Sept. 16	......	......	......	.....
Hickory King	Vick	2	May 6	May 14	Aug. 5	Aug. 5	Aug. 19	Aug. 30	Sept. 27	......	......	......	.....
Hickory King	U. S. Dep. Ag.	2	May 6	May 14	Aug. 5	Aug. 5	Aug. 15	Aug. 30	Sept. 27	......	......	......	.....
Burrill & Whitman	B. & W.	2	May 6	May 14	Aug. 5	Aug. 19	Aug. 23	Sept. 16	Sept. 27	......	......	......	.....
Pride of the North	Vick	2	May 6	May 12	July 13	Aug. 5	Aug. 5	Aug. 12	Sept. 3	7-12	9.8	4-6	7.3
Pisa Queen	U. S. Dep. Ag.	2	May 6	May 13	Aug. 5	Aug. 12	Aug. 12	Sept. 3	Sept. 27	13-18	15.7	7-11	10.3
The Leaming	U. S. Dep. Ag.	2	May 6	May 13	Aug. 5	Aug. 5	Aug. 5	Aug. 19	Sept. 16	11-17	13.5	6-11	8.4
Minnesota King	N. B. & G. Co.	1	May 6	May 14	July 13	Aug. 5	Aug. 5	Aug. 12	Sept. 3	7-13	9.3	3-9	6.3
Sou fodder corn	Perry	1	May 13	May 22	Aug. 12	Aug. 23	?	Sept. 7	....	......	......	......	.....
SWEET.													
Cleveland's Colossal	Clev	....	May 6	May 13	July 17	Aug. 5	Aug. 5	Aug. 26	Sept.	9-14	11.7	4-9	7.6
Crosby's White	Sta	1	May 23	June 6	Aug. 5	Aug. 5	Aug. 5	Aug. 26	Sept.	......	......	......	.....
Stowell's Evergreen	Sta	2	May 6	May 14	July 17	Aug. 5	Aug. 5	Aug. 19	Sept.	......	......	......	.....

VARIETIES OF CORN — TABLE II.

	Date harvested.	Actual stand of plants.	Perfect stand of plants.	Weight harvested, pounds.	Rate actually harvested per acre, pounds.	Per cent of dry matter.	Calculated to Perfect Stand.	
							Yield per acre, green.	Yield per acre, dry matter.
FLINTS.								
King Philip	September 3	630	652	1105	22100	26.635	23030	6134.0
Longfellow	September 2-3	581	652	936	18720	26.385	21007	5542.7
Pride of Dakota	August 12	634	652	626	12520	21.98	12875	2829.9
Waushakum	September 2-3	575	652	1012	20240	28.14	22950	6458.1
A small white flint	September 28	281	326	226	9040	30.94	10488	3712.8
Thoroughbred White	September 28	624	652	1504	30080	26.17	31429	8224.9
Yellow (a local variety)	September 5	576	652	894	17880	29.46	20239	5962.4
DENTS.								
Blount's Prolific	September 28	640	652	1960	39200	29.78	39935	11258.2
Champion White Pearl (Vick)	September 28	309	326	638	25520	23.71	26924	6373.7
Champion Early White Pearl (U. S. Dep. Agricul.)	September 27	294	326	652	26080	28.11	28918	8128.8
Suffern's Champion White Pearl (Suffern)	September 27	314	326	702	28080	27.32	29153	7964.6
Hickory King (Vick)	September 27	448	652	1396	27920	27.14	40410	10967.3
Hickory King (U. S. Dep. Agricul.)	September 27	327	652	1200	24000	24.43	47853	11690.5
B. & W.	September 27	517	652	1898	37960	22.34	47872	10694.6
Pride of the North (Vick)	September 16	649	652	919	18380	33.27	18465	6143.3
Pisa Queen (U. S. Dep. Agricul.)	September 27	580	652	1572	31440	29.22	35343	9427.2
The Leaming (U. S. Dep. Agricul.)	September 27	617	652	1333	26660	30.09	28172	8476.9
Minnesota King (Northrup Braslan & Goodwin Co).	September 16	281	326	416	16640	35.66	19304	6873.8
Sou Fodder	September 28	272	326	676	27040	20.76	32408	6727.9
Cleveland's Colossal	September 27	68	171	160	12201	29.44	32960	9703.4
Crosby's White	September 27	338	481	558	15260	30.94	21540	6664.5
Stowell's Evergreen	September 16	550	652	1154	23080	25.76	27358	7047.4

Three varieties were planted later than the others, but as two of them ripened, the comparison is as fair for them as for any. The earliest variety to ripen, Pride of Dakota, was small, and the ears were set low. Crows attacked the ears and did great damage to the crop before the corn was out of milk stage. No other variety was disturbed by the birds.

It proved to be impossible to harvest all at the same stage of growth, as some of the larger varieties were not so mature when harvested as those cut earlier, although they were allowed to stand very late. Of the earlier cut varieties, a few days intervened in several cases between the time when the majority of ears were showing "glaze" and harvesting. This was the case with two varieties of sweet corn, also Pride of the North, Minnesota King, and the Leaming. Hence these varieties show a lessened yield and higher per cent of, and actually greater amount of dry matter than would have been found if cut at a date between that of appearance of "glaze" and when they were harvested.

With this season, and the length of time allowed in September before harvesting, giving 145 days between planting and harvest, the large late growing varieties have proved to yield greater crops, and also larger amounts of dry matter per acre than the smaller varieties. Yet, while this is true, it must be borne in mind that the lower lands of this region were visited by killing frosts on May twenty-eighth and twenty-ninth, and again on September twenty-second and twenty-third, but which did not kill corn on this farm. To shorten the season thus much, would put a different aspect to the ratio of yields from all our varieties, and it is doubtful if the large varieties could still lead under the different order of things.

It is probable that the dry matter of these varieties which have been cut at different periods of growth, has a different relative composition, and hence somewhat different feeding value. But it is hardly to be expected that these changes in the above crop could equal the differences in yield in favor of the large varieties. One point, in addition to the assurance of a crop, in favor of small varieties, is suggested by a partial investigation of the changes in the composition of sweet corn stalks left standing after plucking the ears.* This point is that considerable gain may be secured by allowing the stalks to stand two to four weeks after removing the ears for roasting or canning.

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*Report of chemist United States Department Agriculture, 1881–2, p. 409.

Since the report containing this data may not be accessible to the reader, the following condensed table presents the results of the analyses made at different times after the ears of corn were plucked. It will be noticed that the most prominent change there found was the increase of sugar. The solids not sugar, also increased a little, thus showing a considerable total gain of dry matter.

ANALYSIS MADE AFTER THE EARS OF CORN HAD BEEN PLUCKED — VARIETY, EGYPTIAN SUGAR.

[Department of Agriculture report, 1881-2, p. 409.]

	Number of days after ears stripped off.	Number of stalks.	Length.	Diameter at butt.	Total weight.	Stripped weight.	Juice expressed.	Specific gravity of juice.	Glucose in juice.	Sucrose in juice.	Solids not sugar.	Polarization.
			Feet.	Inches.	Lbs.	Lbs.	Per cent.		Per cent	Per cent.	Per cent.	Per cent.
Number of analysis, 1	0	1	9.3	.9	2.1	1.1	61.81	1.043	3.56	5.73	1.73	5.61
Mean of 2	7	2	10.25	1.1	1.8	1.4	60.38	1.051	3.11	7.53	2.15	5.70 { 3.87 7.54
Mean of 2	14	4	9.25	1.15	2.5	2.15	59.615	1.0495	3.135	7.685	2.185	7.31
Mean of 2	21	*4	8.15	1.05	1.4	1.15	59.19	1.0584	1.99	10.99	†1.61	‡9.97
Mean of 2	28	7	8.85	1.025	2.05	1.275	52.065	1.0638	3.52	10.52	2.338	§10.98

*Five, including and after specific gravity. †Two were lost. ‡Four determinations. §Two determinations.

TRIAL OF BEETS FOR CATTLE FOOD.

In the same field with the corn and carrot varieties, beets were grown for stock with the following result:

The thinning, weeding and transplanting was done at intervals between showers, and was so broken up that no attempt has been made to determine the cost of time spent. However, it is safe to assert, that the cost of keeping a root crop clean on clay soil, under the discouraging conditions of the past season, costs about all the crop is worth.

The notes at the right of the yields give an idea of the difference in cost of harvesting. Those noted as deep, requiring to be dug, while most of the shallow varieties could be pulled and topped much more rapidly.

The main crop was of Golden Tankard variety, which yielded 14.4 tons per acre. The whole crop of 1.95 acres yielded at the rate of 15.8 tons, or 526.7 bushels per acre.

COMPARATIVE YIELDS OF BEET VARIETIES.

NAME OF VARIETY.	Seed from.	Date planted.	Date vegetated.	Date harvested.	Crop harvested.	Yields Per Acre.			Harvest notes.
						Pounds.	Bushels.	Tons.	
					Lbs.				
Carter's Improved Orange Globe	Vick	May 7	May 15	Oct. 26	1316	29909	498.5	15.0	Shallow rooted and easily harvested.
Carter's Mammoth Long Red	Vick	May 7	May 14	Oct. 26	1337	30386	506.4	15.2	Roots stand high above surface.
Elvethan Long Yellow	Vick	May 7	May 14	Oct. 26	1234	28045	467.4	14.0	Roots stand very high above surface.
French Sugar Mangel	Hallock	May 7	May 14	Oct. 26	1342	30500	508.3	15.3	Roots wholly under surface, tops spreading.
Golden Tankard	Vick	May 7	May 22	Oct. 26	1102	25045	417.4	12.5	Shallow rooted and easily harvested.
Hallock's Long Red Sugar Mangel	Hallock	May 7	May 15	Oct. 26	1628	37000	616.7	18.5	Stand some above surface, easily harvested.
Imperial Sugar	Vick	May 7	May 15	Oct. 26	1111	25250	421.0	12.6	Roots wholly in ground.
Lane's Sugar Mangel	Hallock	May 7	May 22	Nov. 5	1372	31482	524.7	15.7	Roots shallow enough to be easily harvested.
Mammoth Long Red Mangel	Hallock	May 7	May 22	Nov. 5	2176	49445	824.3	24.7	Roots shallow enough to be easily harvested.
Olive Shaped Red	Vick	May 7	May 22	Nov. 5	2000	45454	767.6	22.7	Roots shallow and easily harvested.
Red Globe	Vick	May 7	May 22	Nov. 5	1786	40591	676.5	20.3	Roots shallow and easily harvested.
Red Top Sugar	Vick	May 7	May 22	Nov. 5	1914	43500	725.0	21.8	Roots deep in ground, have to be dug.
White Silesian	Greg	May 7	May 15	Nov. 5	1666	35591	593.2	17.8	Roots deep in ground, have to be dug.
White Sugar Beet	Greg	May 7	May 15	Nov. 5	1630	37045	617.4	18.5	Roots deep in ground, have to be dug.
Vilmorin's Improved French White Sugar	Greg	May 7	May 22	Nov. 5	1656	37636	627.3	18.8	Roots deep in ground, have to be dug.

TRIAL OF CARROTS FOR CATTLE FOOD.

Eleven varieties of carrots were sown, but so poor a stand of plants was obtained that it is hardly worth while to tabulate and calculate them. The five greatest yields per acre are given below but if the blank spaces of row were taken into consideration, the yields from area actually occupied would be much larger.

	Bushels per acre
Long White Greentop	533.8
Imp. Long Orange	511.5
Large White Belgian	495.2
Guerand or Oxheart	430.7
Large White Vosges	363.4

On the whole area devoted to carrots there was produced 11,914 pounds, at the rate of 441.3 bushels per acre.

FERTILIZER EXPERIMENTS WITH GRASS.

In 1888 two duplicate series of one-twelfth acre plats were laid off and fertilized,* with the expectation of learning whether a special fertilizer was needed in either of those fields or whether they would respond best to a complete fertilizer, *i. e.*, a fertilizer containing a moderate percentage of each of the three leading elements of fertility, phosphoric acid, potash and nitrogen.

In one field the indications were that no special fertilizer was needed and there was no very large return from the complete fertilizer.

The other field, however, responded to the application of nitrogen in all the forms applied and yielded an increase of seventy per cent with sodium nitrate.

This season, the first-named field has been broken up and planted to corn, while the series of plats from which the large yields were obtained, have been preserved without further application to test the lasting effect of the various elements. Besides these plats a second similar series has been laid out and fertilized with the same elements in the same amounts, except in case of potassium sulphate, which was of double strength and only half the amount used in 1888 has been applied in 1889. This was to make comparison of climatic conditions, *i. e.*, to see if the field would yield similar results under the different meteorological conditions which different seasons are almost sure to bring.

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* Bulletin No. 13, new series, pp. 63–67. Seventh Annual Report, pp. 340–343.

In addition to the above, a third series of plats has been laid off and termed the nitrogen-test series. These have been designed to determine how much nitrogen would make the most profitable application. The whole is intended to be illustrative of a method of determining what kind, and how much, of any special fertilizer to use, or whether it were better to use none at all for the grass or other leading crop.

METEOROLOGICAL SUMMARY FOR GRASS GROWING SEASON.

For the month of April the

Maximum temperature was 71.8° F. on the twenty-first.*

Minimum temperature was 26° F. on the first.

Mean temperature was 47.3° F.

The relative humidity was 77 per cent.

There were fourteen clear and fair days, sixteen cloudy days, and a total of 163¾ hours of bright sunshine.

The rainfall was 3.28 inches, of which 3.07 inches fell during the last week of the month.

During the month of May the

Maximum temperature was 91.8° F. on the eighteenth.

Minimum temperature was 32.0° F. on the twenty-ninth.

Mean temperature was 61.3° F.

The relative humidity was 77.4 per cent.

There were twelve clear and fair and nineteen cloudy days, and a total of 185 hours bright sunshine; while the rainfall amounted to only 1.21 inches on ten days.

A similar summary for June shows the

Maximum temperature to have been 85° F. on the twenty-second.

Minimum temperature, 46° ? F. on the fifth. †

Mean temperature, 65.9° F.

The relative humidity was seventy-eight per cent.

There were eight clear and fair and twenty cloudy days, while two were cloudy with dense high smoke. Rain fell on fifteen days, giving a total amount for the month of 7.47 inches.

On July second, there was a fall of .39 inches of rain, and again on the night of the third and fourth, .14 inches.

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* Maximum and minimum are given for twenty-four hours previous to 7 A. M. of the date affixed.

The mean is made by dividing the sum of the 7 A. M.+12 M.+twice the 6 P. M. reading by 4.

† Or lower on the sixth. No observation was made for several days on account of broken thermometers.

Thus it will be seen that a copious rainfall, with other favorable conditions, has given as favorable a season for the growth of grass as one could ask.

There has been abundant moisture to dissolve and spread the freshly-applied chemical and other fertilizers in the soil, if not to endanger washing the most soluble down and away in the drains beyond the reach of the plants.

SERIES OF 1888, NOTES ON APPEARANCE BEFORE CUT.

Up to the time the grass was cut it all stood up well, and comparative notes made at several different dates agree that the apparent relation existing between the plats was about as follows:

A. The outline early in the season was distinct by darker color and greater proportion of Timothy, and later seemed rather better than adjoining unfertilized strips.

B. There seemed to be a greater growth here in May than on plat A, but at the time of cutting it appeared to be about the same as on that plat.

C. Gain over intermediate unmanured strips has been all along apparent, and also a larger proportion of clover than on plats A or B has been prominent.

D. About as plats A and B.

E. Not noticeably different from intermediate strips and any of the other plats, F, G, H, I and J, up to near the date of cutting.

F. Same as E, but at date of cutting, while no note was made of condition of E, considerable yellow trefoil was noticed on this plat, and presumably was also on plat E.

G. This plat has not developed a materially different growth from that on intermediate strips.

H. About as those noted under plat E.

I. Classed with E, F. G and H, early in spring, but on date of sampling found to have an increased proportion of clover, and the Timothy was better than on strips and

K. Timothy noted as equal to B, early in spring, and as much better than on intermediate strips and plat J at date of sampling.

L. Poorest of series May tenth, and not noticeably different from strips at harvest.

M, *N*, *O.* All about alike and better growth than on plat L.

The plats were cut with a No. 4 Osborne mowing machine soon after the Timothy was in full bloom and before the pollen had wholly ceased to fall.

Samples were taken from every plat to determine the amount of dry matter. Only single samples were taken of plats A to E, but the remainder were taken in duplicate. All the samples were taken July fifth, and the grass on plats A to J was cut immediately after sampling, but that on plats L to O was cut on the morning of sixth after all dew had disappeared. In taking samples care was exercised to get as near the average of the growth at the point where taken; to cut as near the height that the machine cut as possible, and to get six or seven wisps from nearly equidistant parts of each plat. As soon as taken each sample was cut to short lengths and tied in a tarred cheese cloth and immediately weighed.

Methods of cutting. The grass having been mown up to one side of a plat a strong garden line was stretched over the line on the opposite side and the machine driven as near as practicable with the line of the driver's left. The return trip cut nearly or quite to the line, and while the machine cut the remainder of the plat, a hand scythe trimmed the edge to the straight line. After raking up the plat grass the machine cut away the intermediate and the line was straightened by the hand scythe for the next plat.

This method insured as even a cut for all the plats as could have been desired.

Immediately after cutting each plat and before beginning another, the grass was raked up clear and weighed. After weighing, the grass was spread out to dry. When the first ten plats had been cut and weighed, a second horse was brought into use and the grass loaded on single wagons and each plat drawn separately to the five-ton scales near the barn, weighed and then spread on its own plat. This proved to be more expeditious and less laborious than weighing in the field. The weather was fine for making hay and by noon of the sixth that cut first was ready to be stored, while the last cut required to be turned twice before dry enough to be drawn and weighed as hay, which was done during the afternoon of the sixth.

The tables of harvest weights, with deductions therefrom, are given separately for each series. Each table includes several columns which may be of interest, but which are not essential to show the relation of the yields per plat. These are the weight of green grass per acre; the per cent of moisture lost in curing, and the per cent of moisture left in the cured hay.

YIELDS FROM GRASS PLATS—SERIES OF 1888.

	FERTILIZER APPLIED, 1888.	Amount of fertilizer applied per plat, 1888.	WEIGHT OF GRASS AS HARVESTED.		Per cent of moisture in grass.	Per cent of moisture lost in curing.	Dry matter harvested per plat.	Hay harvested per plat.	Per cent moisture in hay as harvested.	Hay calculated to uniform per cent (31.77) of moisture.	Per cent of increase over mean of unmanured plats.
			Per plat.	Per acre.							
		Lbs.	Lbs.	Lbs.			Lbs.	Lbs.			
Plat A	Sodium nitrate	40	1003	12036	66.38	54.93	337.21	452	25.40	494.2	18.1
Plat B	Ammonium sulphate	26⅔	910	10920	66.38	50.77	305.94	448	31.71	448.4	7.1
Plat C	Barn-yard manure	*	945	11340	68.56	58.94	297.11	388	23.42	435.4	4.0
Plat D	Potassium nitrate	23⅓	895½	10716	67.47	53.77	291.15	414	29.67	426.7	2.0
Plat E	Nothing	......	986	11832	66.82	52.74	327.15	466	29.80	479.4	....
Plat F	Potassium sulphate	33⅓	1041½	12498	70.61	56.99	306.10	448	31.67	448.6	7.1
Plat G	Muck	*	973	11676	67.56	54.78	315.64	440	28.26	462.6	10.5
Plat H	Dissolved bone black	33⅓	1053	12636	70.45	53.85	311.16	486	35.98	456.0	9.0
Plat I	Dissolved bone black Potassium sulphate	33⅓ 33⅓	1235¾	14829	72.13	61.16	344.40	480	28.25	504.7	20.8
Plat J	Nothing	......	857	10284	68.33	54.73	261.41	388	32.63	383.0	....
Plat K	Dissolved bone black Sodium nitrate Potassium sulphate Ammonium sulphate	16⅓ 20 16⅔ 13⅓	1004	12048	69.16	53.38	309.63	468	33.63	453.8	8.4
Plat L	Gypsum	66⅔	780	9360	69.80	52.81	235.56	372	36.65	346.8	....
Plat M	New process, special for winter and spring grain	21	944	11328	68.85	51.70	294.06	456	35.51	431.0	3.0
Plat N	Soluble Pacific guano	21	986	11832	69.96	51.93	296.19	474	37.51	434.1	3.7
Plat O	Nothing	......	822	9864	67.38	48.66	268.14	422	36.46	393.0	....
			962.4				300.06	440	31.77	450.2	
			892				285.57	419	32.96	418.5	

*One horse load.

IN GENERAL.

The crop on all these plats this season consisted of Timothy, Alsike clover, with very little Red clover, some Yellow Trefoil, and on the western side more conspicuously than elsewhere, some Wire grass (*Poa compressa*).

Clovers have been found* to contain a higher percentage of water than grasses. Hence where, as in the case of the crop on these plats, the herbage is mixed, there could easily be a greater yield of green substance accompanying a yield of less dry matter on one plat than on another with which it may be compared. Therefore in making comparisons of the green crop and hay actually harvested, this difference must be borne in mind.

The effect of the nitrogenous fertilizers applied this season, the same as those applied in 1888, has been to stimulate the growth of grass as compared with clover, and to crowd the clover out. This gives a crop of somewhat less water content if the relation of water to dry matter in clover and Timothy found, as cited above, existed on these plats. This point was not specially investigated.

The yields of hay from the several plats were also found to vary considerably in their water content. This might possibly be due to a difference in the ability of the grass and clover to hold moisture — their hygroscopicity — but it is more probable to suppose it to have been mostly due to inequalities in spreading and handling the grass in the process of curing, as it is very easy for different workmen, or the same man at different times, to spread more or less thoroughly, and the thinner spread grass would make the dryer hay.

Taking this view of the case, the dry matter calculated from the actual yields per plat, from the per cent of dry matter found in the samples, has been used to recalculate hay at a uniform per cent of moisture. The average found in each series has been used as the water content for that series, hence there is a difference of 3.89 per cent in the water content of the calculated yields from the two series, that of 1889 being the dryer hay.

This yield of hay corrected to uniform water content appears to be the most reliable set of figures on which to base a comparison of the plat yields, since the green crop has been cleared from the variable amount of water and the hay from differences which probably accrued during curing. Yet we can not at this stage assert that one or other of the yields from these plats may not prove more valuable to feed than another of greater weight, because of excess of some of the more valuable elements.

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* Station report, 1886. page 342; 1888, page 242. Bulletin Illinois Experiment Station, No. 5.

Series of 1888. The yield on plat E is so large that it throws the comparison somewhat out of accord with appearance, as indicated by the notes on growth. Notwithstanding this great yield, for the two years the plats A, B and D have given respectively twenty-one, twelve, and four per cent more hay than E, while plat H has more than held its own.

Comparing the adjacent plats with the others left unmanured, shows an unmistakable gain for the manured plats, except L, which yielded less than any unmanured plat.

Making comparison of every fertilizer plat with the mean of the three unmanured, shows a gain in every case except that of plat L. This gain ranges from two per cent on plat D to twenty-one per cent on plat I. In the cases of plats F, H, I, and perhaps K, the yields seem to have been pushed forward by an increased percentage of clover as compared with Timothy. This is indicated by the higher per cent of moisture as well as by notes on appearance.

The applications of nitrogen alone seems to have had its greatest effect the first season. The after effect was seen in the absence of clover, and in a larger than average growth of Timothy, which did not amount to substance enough to make up for the loss of clover crowded out, and to give a very decided increase of crop this second year over the unmanured plats. The increase from only one plat, A, of this series, has been sufficient to pay for the application of the top dressing.

PLATS FERTILIZED IN 1889.

These plats were fertilized in order to confirm the results of last season. If our soil needs nitrogen, we may expect similar results for another season, when different meteorological conditions might show a different result, if the demand for nitrogen is not urgent. Another series of plats of the same size, one twelfth of an acre, has been laid off in the same field and near by the first series. Six of these plats A-F, lie alongside the first series on the south, while the remainder lie in the same direction across an alleyway one rod wide, as shown in the accompanying diagram.

Fertilizers were applied in the same amounts as in 1888, except that the potassium sulphate contained double the per cent of potash, and only half as many pounds were used. This gave the same amount of fertilizing matter in a little less bulk.

The application of fertilizer and manure was made April eighteenth.

The muck was spread April nineteenth.

Method of application. Garden lines were drawn around the stakes of each plat, and the fertilizer sown broadcast by hand, care being taken to sow thin enough to go over each one about twice, thus insuring an even distribution. The fertilizers had been previously reduced to a fine mechanical condition and thoroughly mixed.

NOTES ON APPLICATION.

As early as May fourth, the outline of plats A, B, D and K could be easily traced by a darker green, and, possibly, by a ranker growth of grass. No differences could be discovered on any other plats at that time.

The meteorological condition for the fifteen days ending with May third was:

Hours bright sunshine, 46.5; days of fair or clear weather, four; cloudy days, eleven; rainfall, 3.195 inches on six days.

Maximum temperature, April twentieth, 84° F.

Minimum temperature, April twenty-third, 26.3° F.

Mean daily temperature, 48.8° F.

Mean relative humidity, 77.4 per cent.

For further notes on the monthly meteorological condition during the period of growth, see the first part of this article.

By May tenth, the plats A, B, D and K were showing a taller growth of Timothy which was of a darker green color and had developed broader leaves. The growth on plat A was rather more regular and seemingly led that on the other three most forward plats.

No other plats at this date showed any noticeable difference from the intermediate strips.

June first, the appearance was practically as above.

June twenty-fifth, the grass on plats A, B, D and K had lodged and on plats H and I; the clover was better than on the intermediate strips.

At the time of cutting, the grass on these plats (noted above as having lodged) was down nearly flat, while on all the others it was upright. Of the lodged grass, Timothy was greatly in excess, as there seemed to be less clover, or less in proportion, than on other plats, and there was very little of any other grass.

There was apparently a greater percentage of clover on plats H and I, where it grew more luxuriantly than on the other plats.

The plats were sampled and cut substantially the same as the series fertilized last season. The samples were all taken before noon of the eighth of July, the grass was all cut on that day and was all made into hay on that and the succeeding day, and weighed and housed on the ninth.

The weather was exceptionally fine for haying during the whole plat harvesting and the hay ought to have been made nearly as average hay.

The harvest weights and other data are given in the same order as for the series fertilized in 1888, and not refertilized this year.

In this series the complete fertilizer on plant K gave the highest per cent of gain closely followed by the plats B, D and A, which received only nitrogen as sulphate of ammonia, nitrogen and potash as sodium nitrate and nitrogen alone as nitrate of soda respectively. The difference between the per cent of gain on these plats is small and in just the reverse order from the results of last year on the first series of plats. This is, without doubt, largely due to the heavy rainfall.

It is doubtless due largely to the solvent action of this heavy fall of rain on the manure that plat C yielded twenty-one per cent increase.

The plat to which muck was applied gave a smaller crop than either of the unmanured plats, and was the only one which did not show a considerable gain as the result of the top dressing, though in no case was the increase enough to pay for the fertilizer used at the market rate for the crop grown, although in two cases the yield was increased from the average of the unmanured plat, 2.434 tons to 3.306 and 3.342 tons per acre respectively.

YIELDS FROM GRASS PLATS — SERIES OF 1889.

	FERTILIZER APPLIED, 1889.	Amount of fertilizer applied per plat.	WEIGHT OF GRASS AS HARVESTED.		Per cent of moisture.	Per cent of moisture lost in curing.	Dry matter harvested per plat.	Hay harvested per plat.	Per cent moisture in hay as harvested.	Hay calculated to uniform per cent. (27.88) of moisture.	Per cent increase over mean of unmanured plats.
			Per plat.	Per acre.							
		Lbs.	Lbs.	Lbs.			Lbs.	Lbs.			
Plat A	Sodium nitrate	40	1188	14256	67.71	54.93	383.61	576	33.40	532.	31.1
Plat B	Ammonium sulphate	26⅔	1168	14016	65.98	50.77	397.35	529	24.89	551.	35.8
Plat C	Barn-yard manure	*	1176	14112	69.86	58.94	354.45	506	29.95	491.5	21.2
Plat D	Potassium nitrate	23⅓	1148	13776	66.24	53.77	387.56	542	28.49	537.4	32.5
Plat E	Nothing	......	852	10224	65.39	52.74	294.88	394	25.16	409.	....
Plat F	Potassium sulphate	16⅔	962	11544	67.87	56.99	309.09	444	30.39	428.6	5.8
Plat G	Muck	*	780	9360	64.68	54.78	275.50	384	28.26	382.	....
Plat H	Dissolved bone black	33⅓	1032	12384	67.77	53.85	332.61	480	30.71	461.	13.7
Plat I	Dissolved bone black Potassium sulphate	33⅓ 16⅔	1140	13680	69.64	61.16	346.10	492	29.65	470.	15.9
Plat J	Nothing	......	864	10368	66.36	54.73	294.65	405	28.23	403.	....
Plat K	Dissolved bone black Sodium nitrate Potassium sulphate Ammonium sulphate	16⅔ 20 8⅓ 13⅓	1190	14280	66.26	53.38	401.51	614	34.61	557.	36.3
Plat L	Gypsum	66⅔	970	11640	65.69	52.31	333.81	448	25.41	463.	14.1
Plat M	Special for winter and spring grain	21	920	11040	63.98	51.70	331.38	404	17.98	459.	13.1
Plat N	Soluble Pacific guano	21	1044	12528	65.48	51.93	360.39	484	25.54	500.	23.3
Plat O	Nothing	......	861	10332	66.07	48.66	292.14	392	25.47	405.	....
			1020	12240					27.88	470.	
			859	10308					26.29	405⅔	

* One horse load.

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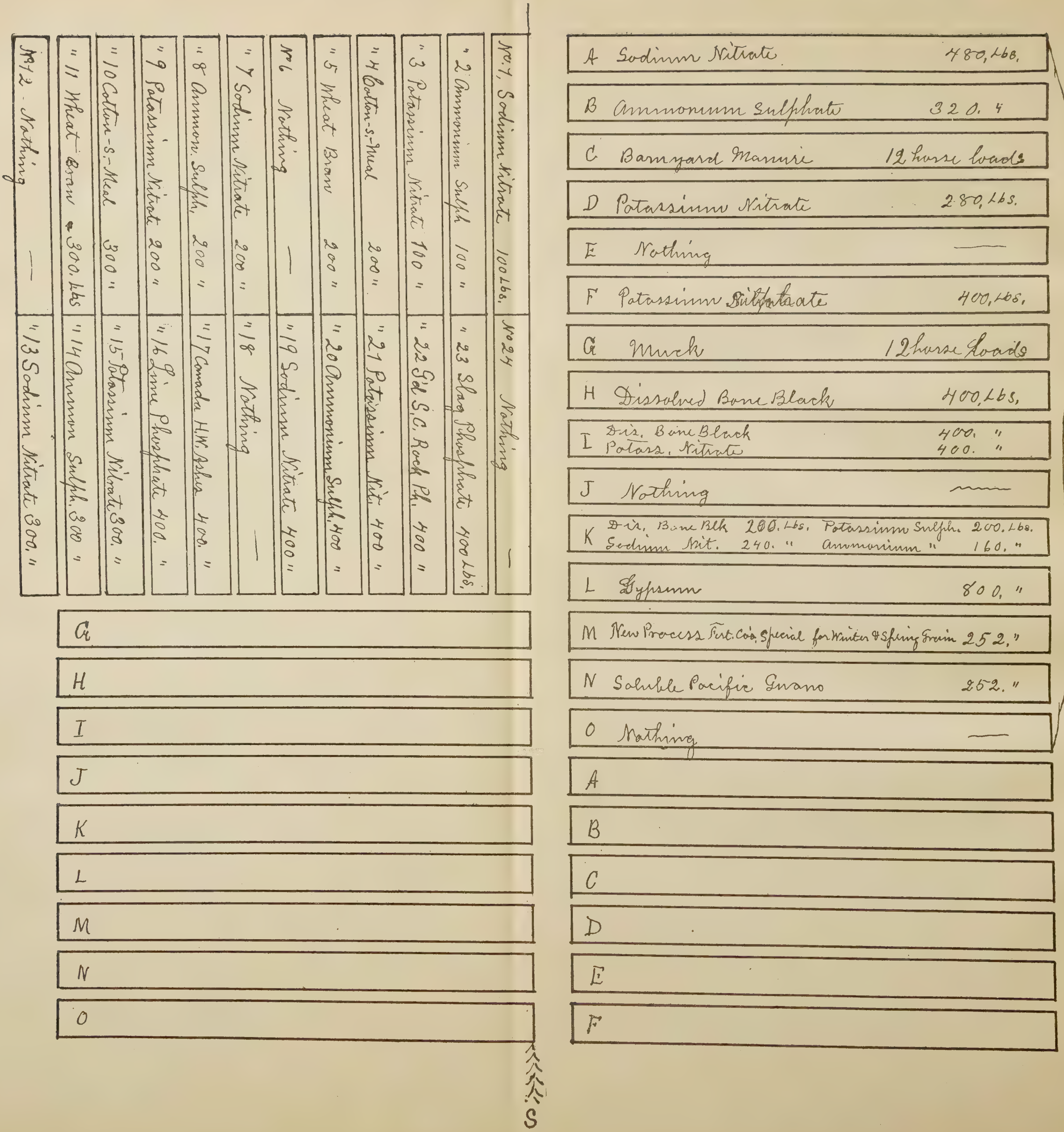

No. 1, Sodium Nitrate 100 Lbs.	No. 24 Nothing —
" 2 Ammonium Sulph 100 "	" 23 Slag Phosphate 400 Lbs.
" 3 Potassium Nitrate 100 "	" 22 G'd S.C. Rock Ph. 400 "
" 4 Cotton-s-Meal 200 "	" 21 Potassium Nit. 400 "
" 5 Wheat Bran 200 "	" 20 Ammonium Sulph. 400 "
No. 6 Nothing —	" 19 Sodium Nitrate 400 "
" 7 Sodium Nitrate 200 "	" 18 Nothing —
" 8 Ammon. Sulph. 200 "	" 17 Canada H.W. Ashes 400 "
" 9 Potassium Nitrate 200 "	" 16 Lime Phosphate 400. "
" 10 Cotton-s.-Meal 300 "	" 15 Potassium Nitrate 300. "
" 11 Wheat Bran 300. Lbs	" 14 Ammon. Sulph. 300 "
No 12 Nothing —	" 13 Sodium Nitrate 300. "

A	Sodium Nitrate	480, Lbs.
B	Ammonium Sulphate	320. "
C	Barnyard Manure	12 horse loads
D	Potassium Nitrate	280, Lbs.
E	Nothing	—
F	Potassium ~~Sulphate~~ Sulphate	400, Lbs.
G	Muck	12 horse loads
H	Dissolved Bone Black	400, Lbs.
I	Dis. Bone Black Potass. Nitrate	400. " 400. "
J	Nothing	—
K	Dis. Bone Blk 200. Lbs. Potassium Sulph. 200. Lbs. Sodium Nit. 240. " Ammonium " 160. "	
L	Gypsum	800. "
M	New Process Fert. Co's. Special for Winter & Spring Grain	252. "
N	Soluble Pacific Guano	252. "
O	Nothing	—

G

H

I

J

K

L

M

N

O

A

B

C

D

E

F

NITROGEN TEST PLATS.

These plats are shown in the accompanying diagram, numbered from 1 to 24.

The ground occupied slopes very gently to the east, while a very few rods in the opposite direction the slope changes to the west.

Several non-nitrogenous fertilizers were put into this series by extending the number of plats for the purpose.

The fertilizers were sown April eighteenth, with two exceptions, which were only delayed until the next morning.

Up to May fourth no particular difference could be pointed out in the growth on the plats. On that date some very slight differences chiefly of No. 3 from intervening strips and its neighbors. This was so small as to be barely appreciable.

By May tenth the nitrogen applications had begun to make their presence felt, and the grass was distinctly better where 100 pounds per acre was sown, than where not sown, while the 200 and 300 pounds per acre had given a still ranker growth, and were noted as being about equal in their effect on the grass. The applications of 400 pounds per acre was showing rather less than the two or three hundred pounds, but more than 100 pounds. Plat No. 4 seemed a very little taller and darker color than the unfertilized strips. There was no more difference with plats 10 and 11. The non-nitrogeneous applications gave no appreciable difference in appearance at this time, nor, indeed, at any time during growth. On June twenty-fifth the grass on plats to which nitrogen salts were applied, had become lodged only a very little on plats 1–3, but more on 7–9, 13–15 and 19–21. The outlines of plats 4 and 5 could be made out by the darker color, while on plats 10 and 11 a ranker growth than on the intermediate unfertilized was more marked than on plats 4 and 5.

These plats were sampled and harvested the same as the above except that only the green grass was weighed and the following differences between time of sampling and cutting the grass.

Sampled grass on plats 1, 2, 3, 4, 21, 22, 23, 24, July ninth.

Cut and weighed grass on plats 1, 2, 3, 22, 23, 24, July ninth.

Sampled all other plats July tenth.

Cut all other plats July tenth, except 1 and 12 which were cut as soon as the dew dried off on the eleventh.

In comparing the green weights it will be seen that in several cases where the grass from one plat has an equal or larger yield than another, by its greater or less per cent of water content, this equality is destroyed or the larger yield reversed when the dry matter is considered. Therefore, since we use hay as a dry product, it seems best to make all our deductions on the dry matter plus an amount of water nearly proportional with that from the other thirty plats. The water content of hay from these plats has therefore been calculated at the average of the above thirty 29.825 per cent.

By referring to the diagram and to the table to note the position and yields from the unmanured plats, it will be seen that the extreme yields of dry matter 15.09 pounds is from the plats 6 and 18 lying nearest together, and that both of the two farthest removed plats, 12 and 24, approach very closely to the mean of the yields from plats 6 and 18.

This difference is considerable when regarding the extremes, but we may reasonably assume, considering the position and yields, that our mean represents as near the average fertility as can readily be obtained. If the appearance of greater fertility extends in reality to those plats lying adjacent to plat 6, and those near plat 18 are relatively as much poorer than the mean as that plat is, then the greatest effect of this difference in fertility will be to exalt the influence of the small applications of fertilizers in comparison with the heavier applications which will be to that extent underrated. In view of the very variable character of our soil and without facts to warrant such a supposition, we are justified in using the mean of the four unfertilized plats for comparing all the yields from fertilized plats.

TABLE III.

Crop on nitrogen test plats.

Plat.	FERTILIZER APPLIED.	Amount per acre.	WEIGHT OF GRASS AS HARVESTED.		Per cent dry matter.	DRY MATTER.		Calculated amount of hay per acre, 29.825% water.
			Per plat.	Per acre.		Per acre.		
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	Sodium nitrate	100	634	12680	34.74	220.25	4405	6276
2	Ammonium sulphate	100	604	12080	37·80	228.31	4566	6507
3	Potassium nitrate	100	628	12560	35.92	225.58	4511	6428
4	Cotton-seed meal	200	578	11560	34.23	197.85	3957	5639
5	Wheat bran	200	602	12040	36.92	222.26	4445	6334
6	Nothing	....	492	9840	37.61	185.04	3701	5274
7	Sodium nitrate	200	632	12640	38.08	240.67	4813	6858
8	Ammonium sulphate	200	582	11640	39.04	227.21	4554	6475

TABLE III — *Crop on nitrogen test plats* — (Continued).

Plat.	FERTILIZER APPLIED.	Amount per acre.	WEIGHT OF GRASS AS HARVESTED.		Per cent dry matter.	DRY MATTER.		Calculated amount of hay per acre, 29,825% water.
			Per plat.	Per acre.		Per acre.		
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
9	Potassium nitrate	200	582	11640	38.17	222.15	4443	6331
10	Cotton-seed meal	300	544	10880	39.27	213.63	4273	6089
11	Wheat bran	300	515	10300	37.37	192.46	3849	5485
12	Nothing	....	479	9580	37.20	178.19	3564	5079
13	Sodium nitrate	300	590	11800	36.09	212.93	4259	6069
14	Ammonium sulphate	300	652	13040	36.88	240.46	4809	6853
15	Potassium nitrate	300	628	12560	36.60	229.85	4597	6551
16	Lime phosphate	400	552	11040	37.27	205.73	4115	5864
17	Canada hard wood ashes	400	625	12500	38.21	238.81	4776	6806
18	Nothing	....	544	10880	31.24	169.95	3399	4843
19	Sodium nitrate	400	614	12280	42.68	262.06	5241	7468
20	Ammonium phosphate	400	710	14200	35.54	252.33	5047	7192
21	Potassium nitrate	400	718	14360	33.80	242.68	4854	6917
22	G'd S. Carolina rock	400	698	13960	33.57	234.32	4686	6669
23	Slag phosphate	400	630	12600	34.67	218.42	4368	6224
24	Nothing	....	528	10560	33.31	175.88	3518	5013

TABLE IV.

Gain by use of different fertilizing materials.

	Amount applied.	Weight of grain from fertilizer.	Value of increase at $10 per ton for hay.	Cost of fertilizer.	For cartage, application and profit.
	Lbs.	Lbs.			
Sodium nitrate	100	1,224	$6 12	$2 50	$3 62
Sodium nitrate	200	1,806	9 03	5 00	4 03
Sodium nitrate	300	1,017	5 08½	7 50	2 11½
Sodium nitrate	400	2,416	12 08	10 00	—2 08
Totals	1,000	6,463	$32 31½	$25 00	$7 31½
Am. sulphate	100	1,452	$7 26	$3 50	$3 76
Am. sulphate	200	1,423	7 11½	7 00	11½
Am. sulphate	300	1,801	9 00½	10 50	1 49½
Am. sulphate	400	2,140	10 70	14 00	—3 30
Totals	1,000	6,816	$34 08	$35 00	$1 03½
Potassium nitrate	100	1,376	$6 88	$6 00	$0 88
Potassium nitrate	200	1,279	6 39½	12 00	—5 60½
Potassium nitrate	300	1,499	7 49½	18 00	—10 50½
Potassium nitrate	400	1,865	9 32½	24 00	—14 67½
Totals	1,000	6,019	$30 09½	$60 00	—$29 90½
Cotton-seed meal	200	587	$2 93½	$2 60	$0 33½
Cotton-seed meal	300	1,037	5 18½	3 90	1 28½
Totals	500	1,715	$8 57½	$5 00	$3 57½
Lime phosphate	400	812	$4 06	......	....
Canada hard wood ashes	400	1,754	8 77	......	....
G'd South Carolina rock	400	1,617	8 08½	......	....
Slag phosphate	400	1,172	5 86	......	....

have

The data has been obtained for this table by taking the cost of fertilizer at the purchase price, without cartage or cost of application, and calculating hay at ten dollars per ton, a common rate in our market.

There are many interesting points and deductions which might be drawn from the data here presented, but, without entering into any detailed discussion, it seems best to present here only the most salient points which were the end sought for in this experiment.

1. On this farm, with our heavy clay soil, nitrogen in an easily soluble form is the predominant element for the grass family.

2. Together with other elements, phosphoric acid and potash do not seem to be needed by this soil, though applications of these two elements, separately and combined, add a considerable percentage to the crop, yet not enough to bring a profit for the application.

3. Of the easily soluble but costly nitrogen salts, light applications are more profitable than greater, and the cheaper and more soluble sodium nitrate than the other forms tried.

4. It is probable that two or three applications, preceding light, rain, would prove more profitable than a single application especially if it should be followed by heavy rain.

5. This single season's trials of cotton-seed meal and wheat bran indicate that they can be profitably used as sources of nitrogen for top dressing grass lands.

6. The effect of spring applications of easily soluble nitrogeneous fertilizers seems to be about exhausted during the season.

7. The second season's influence of phosphoric acid and potash seems to have been to increase the clover, or leguminous plants relatively to Timothy or graminaceous plants.

RELATIVE YIELDS OF FOUR VARIETIES OF BARLEY.

A small bag of Black Hulless barley was received from D. H. Talbot, Sioux City, with the request that it be sown in a competitive test.

At the time there was too little space left for many varieties, so two plats, C 7 and 8, were given to the test, and three other varieties of barleys grown here were compared with that received from Mr. Talbot.

The cropping of the two plats has been just alike since 1882. The crops taken off have been corn, potatoes, corn, two years; potatoes, corn, two years. In that time there were applications of fertilizer to the amount of 2,200 pounds per acre to each plat.

The plats were well fitted for seed, and one longitudinal half of each plat was devoted to each variety of barley.

A quantity of seed equal to that from Mr. Talbot was taken from each of the other varieties, and all were drilled in May fifteenth.

No fertilizer was used.

The Black Hulless grown here made a rather better stand, and grew taller than that from Mr. Talbot. On both of these lots the heads drooped with the weight of grain, and both lodged some before ripe, the shorter considerably the most. On July twenty-fourth the straw of Black Hulless had turned considerably, while the two-rowed had hardly begun to show any indication of ripening, and the four-rowed only in spots. The four lots were allowed to stand until there could be no question but that every one was ripe and the grain filled to perfection. They were cut August sixth.

The gross weight harvested, weight of clean grain, of straw and chaff as well as the same calculated per acre, with the ratio of grain to straw and weight of struck half bushel, taken August sixteenth, is given in the subjoined table.

NAME OF VARIETY.	HARVESTED PER PLAT.			RATE OF YIELD PER ACRE.		Ratio of grain to straw and chaff, 1 to	Weight struck, half bu., August 16.
	Gross weight.	Clean grain.	Straw and chaff.	Bushels per acre.	Straw and chaff.		
	Lbs.	Lbs.	Lbs.		Lbs.		Lbs.
Talbot's Black Hulless	98	28¾	69¼	24	2770	2 3-5	29⅜*
Station Black Hulless, 1883	127	38⅛	88⅞	32	3555	2⅓	29 15-16
Station four-rowed, 1883	104	27¾	76¼	23	3050	2¾	19¼
Station two-rowed, 1883	112	23⅞	88⅛	20	3527	3 7-10	19¾

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*This lot fell short of one-half bushel, and three single pecks were struck, averaging fourteen pounds eleven ounces, viz., 14-10, 14-12 and 14-11.

WARM WATER FOR MILCH COWS.

An experiment was planned for warming water for cows to get some idea of its influence on the yield of milk early in the winter, but the only cows available for the purpose were so far advanced from calving that there could be little hope of affecting their flow materially. Hence the experiment was deferred until a cow came in fresh, and she was paired with a heifer milking with her first calf. Their feed was to have been of the same hay and grain mixture, differing only in the amount eaten. One was to have water at the temperature at which it entered the stable (36° F.), while to make the contrast as great as possible and relieve the other from too much work warming water, the temperature was to be raised to 96° F. No roots or silage were to be allowed in order that all the water consumed should be taken directly and thus help in the trial. During the first few days on the dry food it was feared that sufficient hay would not be eaten, so for two days stover was offered, but so little was desired that it was dropped and the hay increased until it was certainly enough for the wants of the animal.

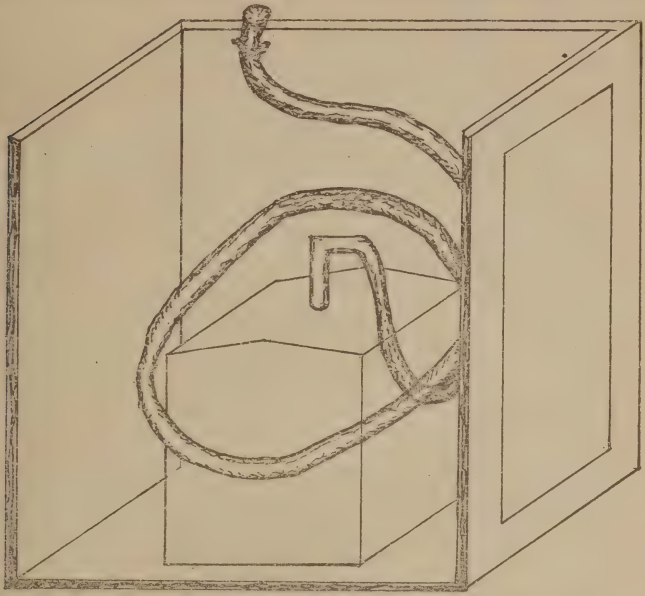
When the cow Juno dropped her calf she was given warm water and manifested considerable eagerness for it, so when she had fairly begun giving a full flow of milk the experiment was begun.

The heifer Belle has always shown a disposition to be shy and to resist anything like familiar approach. This quality soon showed itself in a refusal to drink from a pail and time was lost in teaching her by thirst to drink from a vessel in which the weight of water consumed could be determined. Thus it was March fifth when the experiment was fairly started.

Belle seemed disturbed and out of condition, and on the ninth sugar beets were added to her diet, but when it came to change her to warm water it was refused and she was thrown out of the experiment entirely.

May, another heifer that had dropped her first calf February twenty-seven, four days after Juno dropped hers, was thought of to take Belle's place, but she at first had some swelling in her udder and could not be fairly used. She was, however, given warm water during Juno's cold water period but was continued no longer as the temperature of the air was rising and it seemed impracticable to carry the trial later.

In order to warm the water conveniently a wooden box lined with galvanized iron was adapted for use. The box was twenty-four by eighteen inches, and twenty-seven inches deep. A portion of the bottom was cut out and a box of galvanized iron set in and soldered to the cut edges in the lining of the first. The smaller box was twelve by twelve inches, and thirteen inches high, with a slight roof like pitch on the top, at the apex of which a cylinder five inches long was soldered to connect a coil of lead pipe which acted as a chimney, to assist the draft of the oil stove as well as to help distribute the heat. After prepared for use, the water box (see cut) could be set down over an ordinary oil stove of three or four burners. In practice the box was set up from the cement floor on blocks high enough to allow removal of the stove for filling and trimming, after which it was slid back and raised up to place where it was held by a board resting on blocks.



INTERIOR VIEW OF BOX.

This arrangement worked so well that it was utilized to warm milk for calves and food for pigs in addition to this experiment, and proved to be very cheap heat for these purposes.

The grain fed was a mixture of:

Wheat bran (roller process)	300 pounds.
Corn meal	200 pounds.
Oil meal (old process)	100 pounds.

The hay fed was of good quality and uniform throughout the trial. It was the same as used in the digestion experiment going on at the same time.

TABLE I.

Food consumed and milk yield of Juno, March 5–14, inclusive.

		Temperature of stable, Fahr.: mean of two daily observations.	Weight of cow.	Water drank.		Grain mixture consumed.	Hay fed.		Hay consumed.		Stover fed.		Stover consumed.		Milk yielded daily.	
1889.			Lbs.	Lbs.	Ozs.	Lbs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
March 3......	Begun at night to give water at 96° Fahr..................................	....	......	....		12†	....		....		....		....		....	
March 4......	....	....	......	....		....	....		....		....		....		....	
March 5......	....	41½	1105	83	5	....	20	0	18	7	5	0	2	1	33	11
March 6......	....	41	1081	89	5	....	28	10	20	8	....		....		40	2
March 7......	....	40	1056	129	11	....	26	0	21	2	....		....		37	5
March 8......	....	38	1069	118	10	....	28	0	26	7	....		....		36	8
March 9......	....	37	1089	132	7	....	30	0	27	8	....		....		36	10
March 10......	....	38	1113	54	12	....	30	0	26	9	....		....		38	10
March 11......	....	39	1002	125	0	....	30	0	25	9	....		....		36	1
March 12......	....	40½	1033	156	15	....	30	0	26	1	....		....		39	11
March 13......	....	43	1075	147	13	....	30	0	26	7	....		....		40	8
March 14......	....	40	1116	75	8	....	30	0	25	0	....		....		41	2
	Totals..................................	....	......	1113	6	....	12	0	243	10	....		....		380	14
	Average..................................	39.8	1073	111	3	....	120	0	24	5.8	....		....		*39	3⅓

* For last five days. † Daily

TABLE II.

Food consumed and milk yield of Juno, March 15–24, inclusive.

1889.		Temperature of stable.	Weight of cow.	Water drank.		Grain mixture consumed.	Hay fed.		Hay consumed.		Milk yield, daily.	
			Lbs.	Lbs.	Oz.	Lbs.	Lbs.	Oz.	Lbs.	Oz.	Lb.	Oz.
Mar. 15..	Began morning to give water at 36° F.	42½	1064	64	10	12	30	00	26	7	39	00
Mar. 16..	....	45	1033	119	5	*	30	00	23	15	36	6
Mar. 17..	....	45½	1054	73	9	......	30	00	25	12	36	9
Mar. 18..	....	44½	1032	126	5	......	30	00	25	12	37	8
Mar. 19..	....	47½	1064½	89	6	......	30	00	23	10	38	4
Mar. 20..	....	45½	1054½	110	4	......	30	00	22	14	37	2
Mar. 21..	....	45	1066	121	6	......	30	00	25	8	38	3
Mar. 22..	....	45½	1083	91	11	......	30	00	24	6	38	5
Mar. 23..	....	47½	1072	124	11	......	30	00	23	6	36	15
Mar. 24..	....	49	1067	100	8	......	30	00	25	14	37	4
	Totals	457.5	......	1022	31	......	....		247	8	375	8
	Average	45.8	1059	102	23	......	....		24	00	†37	9

* Daily.

† Average for last five days.

The temperatures given in the tables are the mean of two readings, morning and evening, in the stable. Outside the extremes and mean temperatures were as follows:

	Fahr.
Maximum temperature March 5–14, inclusive	36.0
Minimum temperature March 5–14, inclusive	24.4
Mean temperature March 5–14, inclusive	30.4
Maximum temperature March 15–24, inclusive	44.4
Minimum temperature March 15–24, inclusive	29.2
Mean temperature March 15–24, inclusive	39.0

This test was necessarily too short to be more than an indicator for and introduction to a complete experiment. The first noticeable thing is the good appetite manifested by the cow and the excessive amount of water drank which was only diminished by an average of 9.1 pounds daily when the temperature was lowered 60° F.

Her body weight fell off from an average of 1,073 pounds while on warm water to 1,059 pounds on cold water. The difference of 9.1 pounds of water daily would account for nearly two-thirds of this loss.

The grain ration remained the same and was all consumed during both periods, but during the cold water period the average consumption of hay increased 6.2 ounces per day.

The milk yielded during the ten days March fifth to March fourteenth was 380 pounds, 14 ounces, and for the last five days averaged 39 pounds 3⅓ ounces.

During the succeeding ten days, when the water drank was 60° F. lower the total yield was 375 pounds, 8 ounces, and for the last five days averaged 37 pounds, 9 ounces.

This gives for the warm-water period an excess of 1 pound 10⅓ ounces of milk per day. This period required 6.2 ounces less of hay per day. The temperature of the stable for that period taken twice daily was 6° lower than for the following one, while the outside temperature was 9° F. lower than when the cooler water was given.

Against these items in favor of warming water are to be placed the cost of warming, and the decrease in milk yield from the date of calving which in this case can be discarded because the cow had not at the end of this experiment reached her maximum flow of milk, and the cold water period came last during the period of gain and with warmer environment.

The question resolves itself into whether it is cheaper to warm the water by animal or artificial heat. Its solution in favor of one or the other side depends on circumstances at the place of trial. If the cows were warmly housed and not exposed to cold weather it might be profitable to warm the water, when with the same cows, barn and care, if they were turned out in the yard for daily exercise, more food would be required as fuel, on account of the exposure, than could possibly be saved by warming the water. More time and animals are required for a complete trial of this question.

SUBSOILING EXPERIMENTS.

In order to make a trial of the benefit of subsoiling, one acre was subsoiled in the oat field and another acre in the corn field.

Slight gain by subsoiling oats.—The acre subsoiled in the oat field was so chosen that one-half was on corn stubble which had not been disturbed until the subsoiling, and the other half had been fall plowed after producing a crop of peas and oats. The whole field was plowed about seven inches deep, and a subsoil plow was run in the bottom of the furrow to a depth of about six inches. The soil was well fitted for seed and Welcome oats were drilled in at the rate of two bushels per acre. The Empire State brand of Read & Co.'s fertilizers was drilled in with the oats, using about 400 pounds per acre. Two acres were measured for the experiment, viz., one-half acre fall plowed, but not subsoiled, lying adjacent to the subsoiled acre, and, on the opposite side, one-half acre of corn stubble which was not subsoiled. These plats were for comparison with the subsoiled plats. The crop grew well, but owing to so much wet weather was early attacked by rust and the crop ruined for grain.

The half-acre plats were in long strips reaching across the field from east to west. Notes taken during growth indicated that the subsoiled plats were producing a slightly ranker growth than on either side. The crop was cut by hand, as though the grain had been well filled, and when dry was weighed.

	Yield from half-acre, pounds.
Fall plowed, but not subsoiled	1,418
Fall plowed and subsoiled	1,894
Corn stubble, subsoiled	1,538
Corn stubble, not subsoiled	1,378

The gain in straw and unfilled grain per acre from subsoiling, was therefore 952 pounds on the fall-plowed land, and 320 pounds on the corn stubble.

Loss from subsoiling for corn.—The northern half of subsoiled strip in the corn field was planted to B. & W. corn, also a few rows more than an equal amount on the north, which had not been subsoiled for comparison, while on the southern half King Phillip corn was planted and an adjacent strip taken for comparison.

The cultivation of these plats was the same as that received by the whole field. This was given as the weather and heavy condition of the soil would permit. It was hand hoed, cultivated twice, and then later, the weeds, which, owing to the heavy rains, had only been uprooted and displaced but not killed, were cut out by hand.

The B. & W. corn was used to fill half of the old silo, and six rows each on the subsoiled and not subsoiled plats, which were cut September fifth and seventh, to fill the silo yielded as follows:

	Pounds.	Per acre, tons.
Six rows subsoiled	8,498	15.4
Six rows not subsoiled	11,700	21.2

The King Phillip corn was cut and drawn on the eighteenth of September.

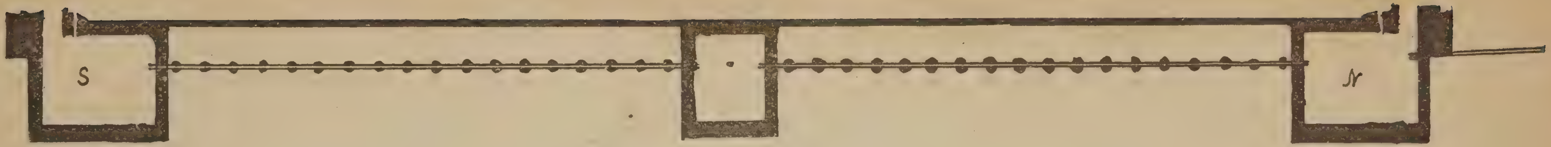
	Yield.	Tons per acre.
	Pounds.	
Six rows subsoiled	8,234	14.92
Six rows not subsoiled	9,282	16.82

The corn was drilled in and suffered some from depredations by black birds, but as no especial effort was made to ascertain the exact loss from each row from this cause, it remains an undetermined factor in the result, but can hardly have been of importance enough to have influenced the yield to the extent of tons. There can, therefore, be no question but that for this season of heavy rainfall and without perfectly good underdrainage, the loosening up of the subsoil was detrimental to the corn crop. This was probably due to retention of much of the excess of water, which ran off over the surface where the subsoil had not been disturbed.

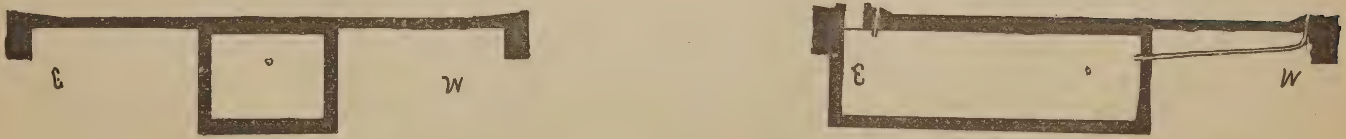
THE MANURE PLATFORM.

Every one who has been observant of farm appearances and wastes must have noticed the black streams flowing away from the ordinary cow-yard, which also serves as the receptacle for all the stable manure made on the farm. That this dark looking liquid carries a heavy load of fertility to the nearest watercourse is certain, and it is just as certain that in ordinary times no farm which is losing its fertility, through this agency, to any great extent, can be paying its owner much profit, if indeed it is not running him behind through careless management.

It is also one of the unnoticeable facts on most farms that the liquid excrements which are most valuable are easiest lost. In order to save to this farm all the fertility of the cattle foods which are consumed about the barns, it was early decided to construct a platform on which to pile the solid excrement and soiled bedding, and to collect the liquid in cisterns which should be pumped over the pile as required, to prevent fire-fanging. Accordingly, this platform has been located and built the past season at a convenient point south of the new barn. The diagrams which accompany this article show the platform in sections on a scale of one inch to ten



Longitudinal Section of Manure Platform Showing Cisterns.



Cross Sections,

Near North End. and Through Middle.

feet. This representation is too small to show very much of the details, hence the following description and dimensions will serve to help the general idea to be obtained from it. The platform is 100 feet long by thirty-six feet wide. The edge is supported by a stone wall two and one-half feet deep by one and one-half feet wide, laid in cement mortar. The bottom of the wall is graded toward the northeast corner, and a two-inch tile was laid at its outer edge to catch soil water and carry it away, and thus help protect the platform from frost. The platform is level except at the sides and ends. The edges are six inches higher than the main floor, and are sloped down in four feet to the level surface.

The earth was leveled and about six inches of stone laid on and rammed solid, then filled with cement wash and covered with two inches of cement.

Under the platform are three cisterns to hold urine from the stables, and overflow from the platform in rainy weather. These cisterns are at the ends and middle as shown. They are built of brick laid in cement mortar, and are plastered inside and out with cement. The end cisterns are of equal size. The dimensions are: End cisterns eight by eight feet, by seven and one-half and seven and one-sixth feet, respectively, below sides of platform; middle cistern five by twenty feet, by seven feet deep. The two sewers from the stables enter the cisterns at three and two-thirds and three and one-half feet below the surface, respectively, which gives the capacity of 1,760, 1,600 and 2,500 gallons, respectively, up to the lowest sewer, with a possibility of 1,500 to 2,000 gallons more in case of an emergency, as a heavy rain when the cisterns are nearly full, before the water would reach back to the gutter behind the stock in the basement of the new barn. The platform when empty holds four inches of water before any runs over into the cisterns, as provided for near the manhole in each, and from the west side to the end of the middle one. The three cisterns are connected by tile with cemented joints, as shown in section at the level of the sewer.

A windmill has been provided, which pumps to a tank from which the liquid is run over to a wagon for distribution, wherever it may be wanted.

REPORT OF ACTING HORTICULTURIST.*

The former horticulturist, Mr. Goff, having severed his connection with this Station on April first, it devolved on me to assume certain of the duties of the office in collecting data, continuing the taking of notes, and other routine work connected with this department. The spring opening very early, gave no time for the planning of new lines of work, in consequence of which there is embodied in this but little beyond the records of plant growth and descriptive notes of the newer varieties of fruits and vegetables. The season has been very unfavorable for the development of plants of the cucurbit family, the melons being destroyed by a fungoid blight which attacked them early in their growth, while cabbage, celery and plants of that class have made a fine growth.

In 1888 it was thought best to change the testing grounds of small fruits, and in consequence of the removal of all such as were then grown here, with the addition of many newer varieties of the several kinds, it is impossible to give a complete description or exact data in regard to their growth or yield that would be reliable until such plants become established in their new quarters. The very thorough study and complete description of the leading varieties of vegetables made at this Station in previous years cover the ground so completely that it has been thought best to confine ourselves to the newer introductions only, and to follow more closely the study and testing of fruits than heretofore, although it will be the aim of this department, as in the past, to thoroughly test novelties, as they are introduced, and publish the results of our observations.

STRAWBERRIES.

The following named varieties of strawberries were planted in the spring of 1888. Many of the older varieties were taken up carefully from an old bed and replanted at once, causing but a slight check in their growth. Others were shipped from long distances and at different times, causing the planting season to be continued into hot weather, and in consequence there was a wide variation in the growth of many of the varieties. The following table, therefore, is only to a certain extent reliable.

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*C. E. Hunn.

The following table will show the variation in bloom and fruit of many of the leading kinds, with a description of their general characteristics, but owing to continued wet weather it is only fair to say that some that seem to have done poorly may redeem themselves in a more favorable season :

	FIRST BLOOM.		FIRST FRUIT.		WEIGHT OF FRUIT.	
	Stool row.	Matted row.	Stool row.	Matted row.	Stool row.	Matted row.
					Ozs.	Ozs.
Bidwell	May 11	May 8	June 9	June 6	26¾	116
Bomba	May 10	May 8	June 11	June 8	52	240
Cardinal	May 15	May 13	June 11	June 12	11-11	12
Charles Downing	May 11	May 10	June 14	June 10	11	164
Cornelia	May 13	May 13	June 18	June 15	7	17
Crawford	May 13	May 13	June 13	June 13	26	18
Crescent	May 9	May 7	June 6	June 4	54	410
Daisy	May 10	May 8	June 10	June 5	51	316
Daniel Boone	May 13	May 10	June 13	June 13	10	91
Excelsior	May 12	May 10	June 14	June 10	45	182
Garden	May 9	May 7	June 8	June 4	......	28
Gold	May 14	May 14	June 14	June 10	......	41
Hampden	May 12	May 9	June 14	June 10	37	125
Haverland	May 12	May 8	June 6	June 4	30	205
Henderson	May 11	May 9	June 8	June 8	......	90
Hoffman	May 11	May 8	June 6	June 6	......	15
Ivanhoe	May 13	May 10	June 10	June 10	14	46
James Vick	May 12	May 9	June 14	June 8	24	147
Jersey Queen	May 13	May 13	June 14	June 12	......	75
Jessie	May 9	May 8	June 4	June 8	8	31
Jumbo	May 8	May 8	June 10	June 4	10	106
Kentucky	May 12	May 9	June 13	June 11	......	53
Legal tender	May 11	May 10	June 8	June 8	38	71
Lida	May 12	May 9	June 10	June 10	34	137
Longfellow	May 11	May 9	June 10	June 6	8	36
Louise	May 9	May 11	June 8	June 10	40	61
Manchester	May 10	May 10	June 14	June 13	49	90
May King	May 12	May 10	June 14	June 6	16	183
Miama	May 13	May 13	June 13	June 10	43	155
Mt. Vernon	May 10	May 10	June 12	June 10	15	135
Mrs, Garfield	May 11	May 8	June 13	June 11	43	80
New Dominion	May 13	May 13	June 18	June 14	10	115
Angers, No. 70	May 12	May 9	June 14	June 14	17	74
Old Ironclad	May 4	May 4	June 6	June 4	15	72
Ontario	May 13	May 15	June 15	June 14	18	89
Parry	May 12	May 8	June 10	June 6	......	21
Pipers Seedling	May 10	May 7	June 14	June 10	24	80
Primo	May 14	May 10	June 14	June 17	15	85
Prince of Berries	May 17	May 14	June 17	June 16	10	97
Sharpless	May 13	May 13	June 15	June 14	20	73
Wilson	May 10	May 6	June 8	June 4	49	80
Woodruff, No. 1	May 9	May 8	June 10	June 6	58	253
Burt's Seedling	May 10	May 11	June 14	June 70	22	163
Dowley	May 14	May 14	June 15	June 18	18	132
Foster's Seedling	....	May 13	....	June 13	......	44
Johnson's Late	May 19	May 17	June	June 27	......	28
Bubach	May 14	May 14	June 15	June 14	47	68
Warfield	May 13	May 10	....	June 14	......	25
New Seedling (Leonard)	May 12	May 10	June 6	June 4	10	157
Farnsworth	May 12	May 9	June 10	June 10	18	145
Mammoth	May 14	May 13	June 15	June 15	19	95
Enhance	May 11	May 9	June 13	June 10	36	218

Length of rows, eighteen feet.

Old Ironclad was the first to bloom, being three days in advance of any others, while seven varieties ripened fruit at the time it did. With but few exceptions the matted row bloomed and fruited from three to five days before the stool row, and, contrary to the usual experience, the largest berries were also on matted rows. The largest yield was from Crescent, but the appearance of several of the other varieties indicated that in a more favorable season some of them may do as well as, if not better than it. And for a market that is at all critical, there are others so superior to Crescent in flavor, that even with a smaller yield the money value will be increased.

A DESCRIPTION OF VARIETIES.

Those marked P are varieties with perfect blossoms, having both stamens and pistils, and able to fertilize themselves, while those marked Imp. are the imperfect or pistillate varieties, which need a variety with perfect flowers planted every three or four rows, to furnish them pollen to perfect their fruits.

The bisexual are those having perfect and imperfect blossoms on the same plant.

Belmont, P.— Wintered poor; growth, medium, vigorous; color of foliage, light green; fruits usually oblong; color crimson, glossy, late firm; good shipper, No. 1; well spoken of and may do well in a more favorable season.

Bidwell, P.— Wintered well; stocky, vigorous; color of foliage, pale green; makes many runners; fruit medium, long; must have rich soil to mature all fruits set; free from rust; No. 2.

Bomba, P.— Wintered fine; rank growth; color of foliage, dark green; makes few runners; enormous yield of green fruit, every berry large size, usually round and conical at end, flattened in extra large fruits; color, very dark scarlet, grows dull color when fully ripe; does well either in stool or matted row; season long; meat of berry high color, distinctly veined; a showy luncheon berry when not too ripe; quality, No. 2.

Bubach, Imp.— Wintered well; growth rank, few runners; foliage, dark green, free from rust; very productive; season late; fruits bright scarlet, large to very large, obtuse conic, flattened in extra large specimens; quality, No. 2; soft.

Burt's Seedling, P.— Wintered well; growth, vigorous, many runners; foliage dark, slightly rusted; productive; late; fruits conical; large fruits irregular, good scarlet color, held good sized until last; firm No. 2; claimed to be identical with Captain Jack.

Bidwell, P.—Wintered well; growth, stocky; foliage, pale green; fruits, oblong, slightly flattened on end, and sides of many bright and showy; medium size, soft; quality No. 3.

Charles Downing, P.—Wintered well; growth, rank; foliage, dark green, liable to rust; fruits, conical, bright red, ripens evenly on all sides, furnishes quantities of pollen, firm; quality, No. 3.

Cardinal, Bisexual.— Growth, weak; wintered poor; makes very few runners, free from rust; fruit, medium late, not very fruitful; color, bright scarlet; medium size, soft, subacid; No. 2.

Carmichael, Imp.—Growth, weak; foliage, dark green, free from rust; makes runners freely; not sufficiently vigorous to give any results this year.

Cornelia, Imp.— Growth, weak; wintered well; makes runners freely; foliage affected with rust; fruits, all small; berry, glossy red, firm; good shipper; No. 2.

Crawford, Bisex.—Growth, vigorous; wintered fair; free of rust; fruit abundant, conical, dark showy scarlet; average, large, firm; quality, A No. 1; makes runners freely.

Crescent, Imp.—Growth, rank; wintered fine; foliage, light green; fruit yield very heavy, of good-sized berries, too soft to ship and of inferior quality; a good showy market berry if not critical.

Crimson Cluster, Bisexual.—Wintered poorly; growth, weak; makes few runners; fruit a little like Jersey Queen, but dark scarlet, small and few; will have to do better than this year to say a good word for it; free from rust.

Daisy, Imp.— Wintered fine; growth, rank; very abundant bearer; fruit, conical, flattened on end, glossy deep scarlet, firm; quality, No. 2; a good berry, not of the largest, but all of good size, holding large through long wet season.

Daniel Boone, Imp.—Wintered well; growth not vigorous; makes runners freely; foliage, light green; fruit, longish conical, abundant, not of the largest size, firm; quality, No. 2.

Dawley, P.—Wintered well; growth, rank, many runners; foliage, light green, free from rust; productive; late; fruits large to very large, first ones, identical with Sharpless, later ones more symmetrical, a little more productive and seems to stand wet weather better.

Enhance.—Wintered well; growth vigorous, very few runners; foliage, good green, slightly rusted; very productive; season late; fruits conical, very showy scarlet, large through picking, firm; quality, No. 1.

Excelsior, Imp.—Wintered well; growth weak, makes many runners; fruits flattened in most specimens, clear scarlet, not very abundant, medium size, soft, mealy; quality, No. 2, free from rust.

Farnsworth, P.—Wintered fair; growth vigorous, many runners; foliage, dark green, slightly rusted; productive; season medium; fruits conical, light red, medium size to end of season, soft but of the finest flavor; a berry that has come to stay.

Foster's Seedling, Imp.—Wintered fine; growth vigorous, many runners; foliage light green, rusts badly; productive; late; fruits oblong conic, in large specimens resembles Sharpless, good scarlet, ripens all over, soft; quality, No. 1.

Garden, P.—Wintered well; growth vigorous; foliage, dark green; makes runners freely; fruits good flavor on the few that ripened; the season seemed too wet for it.

Gold, Imp.—Wintered well; growth vigorous, many runners; foliage, light green; fruit very moderate yield, form peculiar flattened at end, light scarlet, firm, fine flavor; No. 1.

Hampden, Imp.—Wintered fine; growth vigorous, many runners; foliage, deep green, rusts badly; fruits very productive but sets too many fruits to ripen them all, decay rapidly after rains, oblong, bright scarlet, a few large, firm, subacid; No. 2.

Haverland, Imp.—Wintered fine; growth rank, many runners; foliage, dark green, very distinct, free from rust; fruits abundant in immense clusters, long conical with neck, showy scarlet, large to very large, rather soft; No. 2; an attractive berry; would have been one of the very best if the season had not been so wet.

Henderson, P.—Wintered well; growth vigorous, makes runners freely; foliage, dark green, slightly rusted; fruits very few, round to oblong, showy scarlet, medium size, medium early, soft; quality, No. 1, exquisite flavor.

Hoffman's Seedling, P.—Wintered well; growth vigorous, makes many runners; foliage, light green, free from rust; early; prolific;

fruits oblong, bright scarlet, showy, usually large, firm, subacid; No. 2; good shipper.

Ivanhoe, P.—Wintered well; growth vigorous, many runners; foliage, light green, free from rust; prolific; medium season; fruits round, slightly pointed, bright scarlet, very showy, large to very large, firm; quality, No. 1.

Johnson's Late, Imp.—Wintered well; growth dwarf, very vigorous, many runners; foliage very dark green, leaves thick, very distinct; fruits not ripe until June twenty-seventh, bright red, very superior flavor; too late to receive pollen.

James Vick, P.—Wintered well; growth stocky, many runners; foliage, dark green, free from rust; sets a wonderful crop of fruits, but matures very few; does best on heavy clay in this section.

Jersey Queen, Imp.—Wintered well; growth vigorous, many runners; foliage, light green, rusts very bad; fairly productive; late; fruits light scarlet, roundish conical, usually large when well fertilized, soft; quality, No. 1.

Jessie, P.—Wintered fair; growth vigorous, many runners; foliage, light green, slightly rusted; not productive; early and a few large fruits, balance poor; fruits round, rich deep crimson, soft, sweet flavor; No. 2.

Jewell, Imp.—Wintered fair; growth vigorous, but very few runners; foliage dark green, free from rust; not productive; season medium; fruits oblong, deep scarlet, showy, average large, firm; quality, No. 1.

Jumbo, P.—Claimed by some to be identical with Cumberland; wintered fine; growth vigorous, many runners; foliage, dark green, slightly rusted; fairly productive; season medium; fruits obtuse conical, pale scarlet, usually large, soft; quality, No. 2.

Kentucky, Bisexual.—Wintered fair; growth rank, makes many runners; foliage light green, held well up, rusts badly; late; moderately productive; fruits conical, clear scarlet, medium size, soft, No. 2.

Legal Tender, Imp.—Wintered fair; growth rank, many runners; foliage, light green, slightly rusted; early; productive; fruits oblong, large fruits flattened on sides, bright scarlet, showy, usually large, soft, very sweet, devoid of acid; No. 1.

Lennig White, P.—Wintered fair; growth vigorous, many runners; foliage, dark green, slightly rusted; late; unproductive, but a good pollen plant as fertilizer; fruits roundish, light red, small, fine flavor, soft; No. 3.

Longfellow, P. — Wintered well; growth not very vigorous, many runners; foliage dark green; fairly productive; season medium; fruits long, tapering, dark scarlet, usually large, firm; No. 2.

Lida, Imp.— Wintered well; growth vigorous, few runners; foliage, light green, slightly rusted; medium season; enormously productive; fruits round, beautiful, dark scarlet, every berry large; one of the most showy varieties when in fruit, but rot very quickly after being rained on.

Louisa, Imp.—Wintered well; growth very vigorous; foliage, dark green, slightly rusted; season medium; enormously productive; fruits regular, conical, glossy scarlet; resembles Lida, but better flavor; same fault in wet weather.

Mammoth, P.— Wintered fair; growth rank, many runners; foliage light green, badly rusted; very productive; season late; fruits flattened, rounding in some specimens, good scarlet, usually large, soft; No. 1.

Manchester, Imp.— Wintered well; growth vigorous, many runners; foliage dark green, rusts very bad; productive; fruits slightly oblong, often round, light scarlet, from medium to small, firm, subacid; No. 2.

May King, P.— Wintered well; growth vigorous, many runners foliage light green, free from rust; early; productive; fruits almost round, light red, medium large through season, firm; No. 1; a fine table berry, but too light color for market.

Miami, Imp.— Wintered fine; growth medium, many runners; foliage, dark green, slightly rusted; productive; late; fruits oblong, dark scarlet, showy, medium large, soft; quality, No. 1.

Middlefield, Imp., Augurs No. 70.— Wintered fine; growth rank, many runners; foliage, dark green, free from rust; productive; season medium; fruits conical, slightly flattened on some specimens, glossy scarlet, very showy, large through season, firm; No. 1; one of the good ones of recent introduction.

Mrs. Garfield, P.— Wintered fair; growth, weak; many runners; foliage, light green, rusts very bad; unproductive; plants lack vigor; fruits conical, glossy scarlet, soft; No. 2.

Mt. Vernon, P.— Wintered fair; growth, vigorous; few runners; foliage, light green, slightly rusted; not very productive; season, medium; fruits obtuse conical, bright scarlet, medium size, soft; quality, No. 1.

New Dominion, P.— Wintered fine; growth, vigorous, many runners; foliage, dark green, rusts slightly; productive; season, late; fruits obtuse, conical, light scarlet, showy, large through bearing, soft; No. 2; looks like an improved Manchester.

Ohio, Imp.— Wintered poorly; growth, vigorous, few runners; foliage, light green, slightly rusted; not productive; season, late; fruits conical, flattened on sides of large specimens, bright scarlet, from medium large, to small, rather firm, but scalds badly; sour; No. 2.

Old Ironclad, P.— Wintered fine; growth, vigorous, many runners; foliage, dark green, free from rust; usually quite productive; fruit-stems weak; should be mulched to keep fruits clean; fruits conical, good scarlet, firm. No. 2; a good variety to plant with pistillate kinds, as it is well supplied with pollen.

Ontario, P.— Wintered well; growth, vigorous; many runners; foliage, large, dark green, free from rust; habit and fruits same as Sharpless, but proved slightly more productive.

Parry, P.— Wintered poor; growth, medium, many runners; foliage, light green, badly rusted; unproductive; season, medium; fruits obtuse conic, light glossy scarlet, large, soft; No. 2.

Piper Seedling, P.— Wintered well; growth, rank, many runners; foliage, light green, free from rust; productive; season, medium; fruits conical, deep red, almost black when fully ripe, firm; No. 1, rich flavor.

Primo, Bisexual.— Wintered poor; growth, vigorous, many runners; foliage, dark green, slightly rusted; productive; late; fruits obtuse conic, light scarlet, medium sized, firm, No. 2.

Prince of Berries, Bisexual.— Wintered well; growth, vigorous; few runners; foliage, light green, free from rust; shy bearer; late; fruits medium size, round, flattened on end, rich dark red, firm and of exquisite flavor.

Pine Apple, P.— Wintered poorly; growth vigorous, many runners; foliage, light green, free from rust; late; unproductive; fruits, dark scarlet, from round to conical, small, soft; No. 2.

Sharpless, P.— Wintered well; growth, rank, many runners; foliage, large; free from rust; productive; late; fruits of the largest size, irregular in shape, usually flattened on sides, tips usually green when ripe, soft when fully ripe; No. 2; a most satisfactory sort.

Summit, Imp.— Wintered poor; growth medium, many runners; foliage, dark green, slightly rusted; did not have a chance to do any thing, as it was very weak in spring.

Souv. De Bossuet, Bisexual.— Wintered well; growth vigorous, many runners; foliage, dark green, free from rust; unproductive; season medium; fruits nearly round, dark scarlet, usually small, soft; No. 2; a French berry of slight hautboy flavor.

Woodruff, No. 1, P.— Wintered fine; growth stocky, many runners; foliage, dark green, slightly rusted; very productive; medium season; fruits very much misshaped, with hard core, firm; No. 3.

Warfield, No. 1, Imp.— Wintered poor; growth poor, many runners; foliage, dark green, slightly rusted; not very productive this year; early; fruits conical, showy, scarlet, soft; quality, No. 2.

Wilson, P.— Wintered fairly; growth weak, many runners; foliage, light green, rusts badly; has been one of the best, but about run out in this section; considered one of the best for canning.

New seedling, P. (From Leonard).— Wintered well; growth very rank, very many runners; foliage deep green, very large, slightly rusted; productive; early; fruits conical, dark glossy scarlet, large, firm; No. 2; will prove a good berry.

Seedling from William Lyons, Imp.— Wintered fair; growth vigorous, many runners; foliage dark green, slightly rusted; productive; season medium; fruits from round to conical, deep scarlet, usually large, firm, flavor pronounced; No. 2.

In addition to the described varieties, we have had sent to us this year the following-named varieties:

Coleman's No. 1.
Felton.
Gandy.
Monmouth.
Stayman's No. 1.
Stayman's No. 2.
Lady Rusk.
Long John.
Russell's Advance.
Cloud.
Viola.
Smith's No. 7.
Mt. Vernon.
Windsor Chief.
Captain Jack.
Hinman.
Scarlet Queen.
Minneola.
Fragaria Virginiana.

These have all made a fine growth, and we hope to be able to give a good report on them next year.

ON SELECTING POLLEN PLANTS FOR CROSSING THE STRAWBERRY.

It would seem that there is a field for careful study in making crosses or originating new varieties. One finds an early variety of fine flavor but a poor yielder, and often the first thought is to supply it with pollen from a more productive one, even if much later, hoping to transmit at once the productiveness of one to the earliness and quality of the other. Or fruits are chosen here and there from a patch containing several varieties, and the chances taken that they will produce something better than the original.

We have had growing on the Station grounds the last two years 1,000 seedlings, many of them crosses, and of that number but twenty have been saved as showing any indications of being superior to the varieties of which they are seedlings. But in the study of them, several valuable hints have been learned, which will be taken advantage of when occasion offers. In the following table will be found the variation in the different crosses, as well as those seedlings from fruits that were not artificially crossed.

It would appear that a variety as vigorous, and as well supplied with pollen, as the Sharpless would be more potent to carry its pollen than one of the habit of Lennig White, which, although a good grower, has but few blossoms and but little pollen. But as the reverse has been a fact in this case, it would seem that in improving a very late pistillate variety of rugged habits and fine flavor, but blooming after all the staminate varieties had mainly ripened their fruit, it would be of great advantage to know and use a pollen variety most likely to perpetuate itself in the blossom while the other characteristics of the seedling follow the strong growth and fine flavor of the pistillate plant.

ORIGIN.	Number of seedling plants.	Number of plants with perfect blossoms.	Number of plants with pistillate blossoms.
Cumberland fertilized with Wilson	48	21	27
Crescent fertilized Lennig's White	65	35	30
Crescent fertilized Sharpless	34	9	25
Seedling Wilsons, P	46	46	....
Seedling Daniel Boone, Imp	74	40	34
Seedling Crescent, Imp	50	11	39
Seedling Sharpless, P	40	39	1
Seedling Legal Tender, Imp	31	10	21
Seedling Golden Defiance	44	15	29
Seedling James Vick, P	12	8	4
Seedling Mrs. Garfield, P	47	44	3
Seedling Charles Downing, P	41	34	7
Seedling Old Ironclad, P	40	37	3
Seedling Manchester, Imp	34	13	21

DESCRIPTIVE NOTES ON AND TABLE OF YIELD OF RASPBERRIES.

The remarks on strawberries hold good in regard to raspberries, as they were planted at different times through the season, and did not all have the same start.

RASPBERRIES.	First leaves appeared.	First flower opened.	First ripe fruits.	First picking.	Last picking.	Weight in ounces.
Ada	April 17	June 1	July 8	July 10	July 23	41
Brandywine	April 17	June 14	July 6	July 12	July 23	12
Caroline	April 17	May 29	July 1	July 3	July 24	72
Champlain	April 17	May 30	July 1	July 8	July 24	38
Crimson Beauty	April 17	June 3	July 9	July 12	July 20	10
Crystal White	April 17	May 30	July 1	July 8	July 25	23
Cuthbert	April 16	June 7	July 8	July 10	July 23	39
Erie	April 17	May 31	July 3	July 5	July 23	32
Golden Queen	April 15	May 30	July 8	July 10	July 31	108
Hansell	April 17	May 30	July 1	July 8	July 23	21
Lost Rubies	April 19	June 5	July 5	July 10	July 23	17
Macomber's No. 2	April 15	May 29	July 1	July 10	July 31	51
Marlboro	April 16	May 28	June 28	July 3	July 23	16
Meredith Queen	April 17	June 7	July 9	July 12	July 31	46
Miller's Woodland	April 18	June 7	July 5	July 10	July 31	33
Montclair	April 19	May 31	June 28	July 5	July 31	53
Naomi	April 20	June 6	July 10	July 8	July 31	55
Orange	April 17	May 30	July 1	July 8	July 23	27
Philadelphia	April 19	May 29	July 5	July 8	July 31	84
Pamona	April 17	May 31	July 5	July 10	July 23	12
Rancocas	April 19	May 22	June 26	July 13	July 18	27
Reder	April 20	May 31	July 3	July 9	July 31	44
Reliance	April 16	May 29	July 5	July 9	July 29	25
Shaffers	April 18	June 3	July 8	July 12	July 31	40
Silver Queen	April 18	June 3	July 3	July 9	July 24	34
Superb	April 18	June 6	July 6	July 12	July 31	34
Thomson's Early Pride	April 19	May 30	June 28	July 3	July 31	35
Thomson's Early Prolific	April 19	June 1	July 1	July 1	July 29	66
Turner	April 15	May 29	July 3	July 9	July 29	33

Ada. — Similar to Gregg in many respects; growth rank; foliage, deep green; canes large, light green, with delicate bloom; color of fruits showy black; average large.

Brandywine or Thwack.— Growth vigorous, stocky; foliage, rich dark green, suckers freely; fruit dark red, strong flavor, good shipper.

Crystal White.— Growth vigorous; foliage, deep green; fruits light lemon, easily stains and becomes worthless for market; the flavor very rich in ripe fruits.

Philadelphia.— Growth very vigorous; foliage, dark green; canes rather tender for this climate; fruits dark crimson, soft.

Naomi.— Growth vigorous, few suckers; foliage, dark green; canes have but few laterals and with but few thorns; fruits light red, firm; medium late.

Orange.— Growth of canes vigorous but dwarf; foliage, dark green, tips of canes lighter; fruits orange, slight musky flavor, no improvement on Golden Queen or Carolina.

Macomber's No. 2.— Growth vigorous; foliage, dark green, bearing wood and new canes same in color, light green with thin bloom, thorns numerous and stiff; fruits when fully ripe resembles Blackcap, but with a faint raspberry flavor.

Pomona.— Growth vigorous, dwarf; foliage, rich glossy green.

Carolina. — Growth vigorous, erect, suckers freely; foliage, deep green; few thorns; very productive, hardy and of fine flavor, but too soft for shipment; seems to be a failure in some sections.

Champlain.— Growth very vigorous; foliage, rich green; bearing canes; often have bark split and curl; numerous small thorns; young leaves very much wrinkled; has proved quite productive on one year set canes.

Crimson Beauty.— Growth not very vigorous; bore but few fruits the past season; those large and of fine appearance; quite firm.

Cuthbert.— Growth, vigorous, erect; foliage, deep green; fruits, large, conical, dull crimson when fully ripe, firm and sweet; a good market or home berry.

Erie.— Growth, vigorous; foliage, dark green; fruits, medium size, color of Philadelphia; productive and bears a fair crop on young canes in fall.

Golden Queen.—Growth very vigorous; foliage, dark green; fruits, fine shade of yellow that takes well in market, of good size, firm and of exquisite flavor; outyielded all others on our grounds this year, two to one; supposed to be a seedling of Cuthbert.

Hansell.— Growth not very vigorous; claimed to be the earliest red raspberry, but was only medium season here; fruits of medium size, bright red, and firm; not as productive as some that have proved as early.

Lost Rubies.—Growth very vigorous, suckers freely; foliage, deep green; fruits resemble Naomi in some respects; liable to winter-kill.

Marlboro.— Very early; growth of last year's canes weak but well fruited, new growth strong, tips of canes bright red; fruits bright scarlet, sweet, of good size.

Meredith Queen.— Growth of canes vigorous, bearing canes dark brown, new growth purplish green, tips red, suckers freely; productive; fruits soft, of good flavor, when ripe reddish salmon.

Miller's Woodland.— Growth weak, suckers freely; bearing canes brown, small thorns; fruits of medium size, bright crimson and firm; quite productive.

Montclair.— Growth vigorous; foliage, dark green; bearing canes dark brown, new growth vigorous, leaves very much wrinkled, suckers freely; early; very productive; fruits of good size, dark crimson, almost too dark for a good market variety.

Rancocas.— Growth weak and dwarf, suckers freely; foliage, pale green; very early and productive and ripens in short season; fruits good size and firm.

Reder.— Growth very vigorous; suckers freely; foliage, large, rich green leaves; very productive of pale red fruits; quality fair, but crumbles badly.

Reliance.— Growth vigorous; foliage, deep green; fruits much like Philadelphia.

Shaffer's Colossal. Red.— Growth very rank, does not sucker, but roots from tips. A good home berry and now in demand as a canning berry. An enormous yielder of large fruits. Extremely hardy. Berries, too dull a color for market.

Superb.—Growth vigorous; foliage, light green; fruits late, stands wet season well; firm; subacid; very dark for market.

Thompson Early Pride.— Growth very vigorous, suckers freely; foliage, dark green; early; productive; fruits clear red; firm.

Thompson's Early Prolific.— Growth vigorous, canes stocky, suckers freely; foliage, dark green; fruits a little larger than the foregoing, firm and produced abundantly.

Turner.— Growth vigorous; foliage, deep green, tipped with brown; productive; fruits bright scarlet, hairy, soft, with high flavor.

Currants.

Baldwin's Black.
Black English.
Black Naples.
Champion Black.
Crandall.
Lee's Black Prolific.
Ogden's Black Grape.
Prince of Wales.
Saunders, No. 1.
Saunders, No. 2.
Cherry.
Fay's Prolific.
Glorie des Sablons.
London Red.
Prince Albert.
Red Dutch.
Red Flowering.
Seedling White.
Versailles.
Victoria.
White Dutch.
White Grape.
Champion.

The above varieties of currants were planted in the spring of 1888. As noted in remarks on small fruits, they have, with few exceptions, done well, and will be in bearing sufficient for tests next year. A number of them have been reported on in previous years, but have been continued to afford a comparison with newer ones. The data gathered from them this summer contain the spring condition, appearance of leaves and growth through summer. As very few of them blossomed, and as these held but few fruits, it has been thought best to omit the fruit description until the future.

Blackberries.

The plantation of blackberries set in spring of 1888, consisted of the following varieties. Those marked thus * were unable to survive the check of transplanting and the unusual extremes of the following winter, and have been replaced by others of the same variety this year:

Agawam.
Ancient Britton.*
Cyrstal White.
Dorchester.*
Early Cluster.*
Early Harvest.*
Evergreen.
Kittatinny.
Lawton.*
Minnewaska.*
Snyder.
Stayman's Early.*
Stone's Hardy.
Taylor's Prolific.
Wachusett.*
Wilson's Early.
Wilson's Junior.
Barnard.
Thompson's Early Mammoth.
(Dew-berries.)
Bartells.
Lucretia.
Mammoth.

This has been an extremely favorable summer for the growth of these plants, and without an extraordinarily cold winter they will be in fine condition for testing in 1890.

GOOSEBERRIES.

Crown Bob.
Crystal.
Downing.
Houghton.
Industry.
Mountain Seedling.
Pale Red.
Payallup Mammoth.
Smiths.
Triumph.
Wellington's Glory.
Whitesmith.
New Gooseberry.
Pearl.

Crown Bob.— Growth stocky; fruits large to a very large, red streaked with green in ripe specimens, little bloom, oval to oblong, superior flavor, hairy.

Crystal.— Growth medium tall; fruits light green, oval, subacid.

Downing.— Growth vigorous; prolific; fruits large, whitish green, soft, juicy and fine flavor; a good market variety.

Houghton.— Growth vigorous; plants low and stocky; fruits pale red, smooth skin, flesh tender.

Industry.— Growth very vigorous; an enormous bearer of large, oval, dark red fruits of rich flavor.

Mountain Seedling.— Growth slender, branches liable to split in high winds; fruits oblong, green, streaked with red when ripe, good flavor.

Pale Red.— Resembles Houghton except habit of growth, which is more vigorous; fruits smaller, but is claimed to be a better bearer.

Smiths.— Growth good; fruits small, very sweet.

Wellington's Glory.— Growth vigorous; fruits oval, yellowish green, large, subacid.

Whitesmith.— Growth vigorous; fruits very large, round, transparent, distinctly veined, very sweet.

Pearl.— Growth vigorous; resembles Downing, except fruits are larger.

BEANS, PEAS, AND CORN.

BEANS.

The following table gives the results of observations made during this season upon several varieties of beans under cultivation:

BEANS.	Seeds from.	Planted.	First vegetation.	First bloom.	Days from planting.	Pods of edible size.	Days from planting.	Harvested.	Number of pods on 10 plants.	Number of beans in 100 pods.
BUSH.										
Alexander's Black Wax	Alex.	May 8	May 14	June 22	45	July 4	57	Sept. 22-30	160	405
Cylinder Black Wax	Hen	May 8	May 14	June 25	48	July 4	57	Sept. 22-30	142	515
Dwarf Carolina*	Land	May 8	May 14	July 8	61	......	......	Sept. 22-30	155	252
Date Wax	Fery	May 8	May 15	June 24	47	July 4	57	Sept. 22-30	70	435
Early Golden-eyed Wax	Greg	May 8	May 14	June 25	48	July 6	59	Sept. 22-30	104	477
Everlasting	Greg	May 8	May 14	June 28	51	July 9	62	Sept. 22-30	140	285
Flageolet Scarlet Wax	Fery	May 8	May 15	June 25	48	July 7	61	Sept. 22-30	95	380
Flageolet Violet Wax	Fery	May 8	May 16	June 29	52	July 9	63	Sept. 22-30	80	391
Kindney Cranberry	Batch	May 8	May 17	June 29	52	July 12	66	Sept. 22-30	180	347
Prolific German Wax	Fery	May 8	May 15	June 25	48	July 9	63	Sept. 22-30	170	520
Red Windsor*	Thor.	May 8	May 23	June 20	43	......	......	Sept. 22-30	......	......
Thorburn's Pride of Newtown	Thor.	May 8	May 16	June 25	48	July 9	63	Sept. 22-30	126	401
Wardwell's New Kidney Wax	Thor.	May 8	May 16	June 22	45	July 9	57	Sept. 22-30	97	442
White Wonder	Everett	May 8	May 15	June 26	49	July 12	66	Sept. 22-30	352	475
Yosemite Mammoth Wax*	Hen	May 8	May 18	June 29	52	July 9	63	......	......	......
Yellow-eye Golden Wax	Raw.	May 8	May 15	June 25	48	July 4	57	Sept. 22-30	130	465
New	Hatt.	May 8	May 15	June 29	52	July 14	68	Sept. 22-30	227	526
Excelsior Wax	Ford	May 8	May 17	July 15	69	Aug. 5	90	Sept. 22-30	207	400
No. 1 New	Alex	May 8	May 15	June 25	48	July 9	63	Sept. 22-30	137	485
China Red Eye	Keeney	June 3	June 11	July 10	37	Aug. 5	63	Sept. 22-30	40	397
Mohawk	Keeney	June 3	June 12	July 10	37	Aug. 7	65	Sept. 22-30	133	328
Mont d'Or	Keeney	June 3	June 11	July 12	39	Aug. 3	61	Sept. 22-30	35	370
White Wax	Keeney	June 3	June 12	July 12	39	Aug. 1	59	Sept. 22-30	90	368
Cylinder Ivory Pod	Jones	May 15	May 29	July 3	49	Aug. 15	61	Sept. 22-30	240	428
Dwarf Lima	N., B. & G. Co.	May 8	May 15	June 25	48	July 15	69	Sept. 22-30	130	760
Kumerle's Dwarf Lima	Thor	May 8	May 18	July 14	67	......	......	Oct. 1	248	292
New Bush Lima*	Hen	May 8	May 16	July 14	67	......	......	Oct. 1	550	270
POLE BEANS.										
Early Jersey Lima	Fery	May 9	May 20	July 10	62	......	......	Oct. 3	976	220
Early Morning Lima	Hallock	May 9	May 17	July 7	59	......	......	Oct. 3	425	303
Ford's Mammoth Long Pod	Liv	May 9	May 18	July 6	58	......	......	Oct. 3	738	354
Giant Red Wax	Fery	May 9	May 17	July 6	58	......	......	Oct. 3	333	540
New Golden Andalusian Wax	Everett	May 9	May 17	July 9	61	......	......	Oct. 3	190	394
Rhode Island Crease Back	Fery	May 9	May 17	July 12	64	......	......	Oct. 3	670	518
Ruby of Erfurt	Thor	May 9	May 17	July 3	55	......	......	Oct. 3	48	289
Ruby Climbing†	Byer	May 9	May 17	July 3	......	......	......	......	......	......
Vermont Early Lima	Alex	May 9	May 17	July 5	57	......	......	Oct. 3	454	330

* Beans not edible when harvested. † Of no value.

DESCRIPTIVE NOTES: BUSH BEANS.

Alexander Black Wax.— Plant fifteen inches high; foliage, light green; flowers, pale pink; pods usually borne singly; stem recurved at apex, four to four and one-half inches long, yellowish white, somewhat wrinkled when fit for string bean.

Cylinder Black Wax (Syn. Cylinder Ivory Pod).— Plant twelve inches high; foliage, very light green; flowers small, purple; pods usually borne singly, strongly recurved, four inches long, pale yellow, wrinkled when string bean; beans deep black, long.

Dwarf Carolina.— Plants ten inches high; foliage, deep glaucous green; flowers very small, white, borne on erect pods as many as twelve, flat, short.

Date Wax.— Plants fifteen inches high; foliage, light green; flowers pale pink; pods often in pairs, slightly recurved, from five and one-half to six inches long, smooth, very light yellow when string bean; beans long, slightly bowed, dun color.

Early Golden-eyed Wax.— Height of plant fifteen inches; color lively green; flowers white, small; pods usually single, strongly recurved, four to five inches long, smooth, golden yellow; beans medium size, white eye splashed with dull yellow; identical with Yellow-eye Golden Wax.

Everlasting.— Plants ten inches high; foliage, dark green; flowers, pale pink; pods borne singly, strongly recurved at apex, three to four inches long, very much wrinkled; beans long, brown spotted, with dark red.

Flageolet Scarlet Wax.— Plant fifteen inches high; foliage, light green; flowers, pink; pods borne singly, sharply recurved, five to six inches long, wavy, golden yellow; beans, long, somewhat bowed; dull scarlet.

Flageolet Violet Wax.—Habit of growth same as above; beans, dull violet and brown.

Kidney Cranberry.— Plant two and a half to three feet; should be bushed; foliage, lively green; flowers, white, pink tint; pods borne singly, flat, very much wrinkled, five to six inches long; beans, white, splashed with dull red, long and thick,

Prolific German Wax.— Plant twelve inches high; foliage, deep green; flowers, light purple; pods usually borne singly, strongly recurved, three and a half to four inches long, smooth, golden yellow; beans, medium size, blue-black, white eye.

Thorburn's Pride of Newtown.—Plant, fifteen to eighteen inches high; foliage, rich green; flowers, pale pink; pods borne singly, straight, five to six inches long; beans, long, slightly bowed, dun color, very much like Date Wax.

Wardwell's New Kidney Wax.—Height of plant eighteen inches; foliage, light green; flowers pure white; pods borne singly, recurved, crescent shape, five to seven inches, smooth, golden yellow; beans long, slightly bowed, white eye, splashed with dull purple.

White Wonder.—Twenty to twenty-four inches high; foliage, deep green; flowers pure white; pods borne in pairs, straight, four to four and a half inches long; beans white, round.

Yosemite Mammoth Wax.—Height ten inches; foliage, dark green; flowers purple; pods often in pairs, very much recurved, often crescent, much swollen when beans are ripe; beans five to six inches long, golden yellow.

Yellow-eye Golden Wax.—Habit of growth, yield and product, identical with Early Golden-eyed Wax (Greg.).

New Bean (Hatt.).—Claimed to be as fine in flavor as Lima; height, two and a half to three feet, should be bushed; foliage, very dark green; flowers white; pods borne usually in pairs, flat, crescent; beans large, half round, pure white.

Excelsior Wax.—Height two and a half feet, inclined to run, should have pole; foliage, light green; flowers white; beans white, half round, thick.

No. 1 *New* (Alex.).—Height of plant eighteen inches; foliage, light green; pods borne singly, slightly recurved at apex, four to four and a half inches long.

China Red Eye.—Height of plant fifteen inches; foliage light green; flowers white; pods usually single, half long; beans long, white, eye splashed with dull red.

Mohawk.—Height of plant eighteen inches; foliage, rich dark green; flowers light blue; pods borne singly, recurved; beans long crescent, dull purple, splashed with white.

Dwarf Mt. d'Or.—Height of plant six to eight inches; foliage, very light green; flowers light purple; pods usually in pairs; beans oblong, short, purplish black.

White Wax.—Dwarf, eight inches high; foliage, light green; flowers white; pods four to six on peduncle, golden when string; beans medium size, white.

Cylinder Ivory Pod.— Height of plant fourteen inches; foliage, light green; flowers small, purple; pods usually single, strongly recurved, three and a half to four inches long, pale yellow when string bean; beans long, deep black; identical with Cylinder Black Wax (Hen.).

Dwarf Lima (N., B. & G. Co.).— Height of plant eighteen inches to three feet, should be bushed; foliage, deep green, leaves same as bush beans; flowers white; pods borne from singly to four, flat, slightly recurved, five to six inches long.

Kumerles Dwarf Lima.— Height of plant ten to twelve inches; foliage marbled green, true Lima leaf; flowers very small, white; beans large, thick, meaty, a little larger than Dreer's Improved, but more of old Lima shape; season late, not ripe when picked October second.

New Bush Lima.— Height of plant ten to twelve inches; foliage rich green; flowers very small, white; beans very small, but few ripe when harvested October second; seems to be identical with Dwarf Carolina.

BEANS — LIMA.

Early Jersey Lima.— Height eight to ten feet; foliage, light green; flowers small, white; beans large, flat, showy, matured most of crop at harvest, October first.

Early Morning Lima.— Height of plant eight to ten feet; foliage, light green; flowers small, white; smaller than Early Jersey and not ripe at harvest, October first.

Giant Red Wax.— Height ten to twelve feet; foliage, light green, leaf same as bush bean; flowers yellowish white; pods mottled; beans short, thick, bright red; too late to ripen this season.

New Golden Andalusian Wax.— Height eight feet; foliage, dark green, leaf same as bush bean; pods usually in pairs, long; beans half round, very thick; late.

Rhode Island Crease Back.— Height of plant ten feet; foliage, dark green, leaf same as bush bean; pods half long; beans long, thick, white, thickly spotted and veined with drab.

Ruby of Erfurt.— Plants made a very weak growth and became diseased early in the season; flowers light pink; pods borne singly, slightly recurved, three to four inches long, ruby color; beans kidney shaped, dull white, veined with purple.

PEAS.

A description of three of the newer varieties of peas is as follows:

Bergen Fleetwing.— An early smooth pea; quality fair; plant three feet high; foliage, light green; pods usually borne singly, two to two and a half inches long, lighter green than foliage; productive.

Carter's Anticipation.— A late wrinkled variety, large and of very fine flavor; medium productive; plant three to four feet high, light green splashed with white; pods usually in pairs, long, flat; resembles very closely American Beauty.

Summit.— Height of plant three feet; foliage light green; pods usually borne singly, straight, from two to two and a half inches long, slightly wrinkled; peas small, smooth; enormously productive.

The following table presents the comparative observations made in the field, of the different varieties grown:

PEAS.	Seed from.	Date planted.	First vegetation.	First bloom.	Edible maturity.	Days from planting.	Last edible maturity.	Days in bearing.	No. of peas in 100 pods.
American Champion	Sta	April 18	May 2	June 4	June 19	62	July 14	25	565
Alaska	Sta	April 18	May 2	May 27	June 9	52	July 10	31	557
Bergen Fleetwing	Greg	April 18	May 1	May 27	June 8	51	July 14	36	532
Carter's Anticipation	N., B. & G. Co.	April 18	May 4	June 14	July 10	83	July 22	12	305
Saxton's Earliest of All	Sta	April 18	May 2	May 29	June 8	51	July 9	31	567
Summit	N., B. & G. Co.	April 18	May 2	May 28	June 8	51	July 10	32	615
Black-eyed Marrow	Kinny	May 18	May 23	July 5	July 27	70	Aug. 12	16	455
American Wonder	Kinny	May 18	May 23	June 18	July 8	51	July 20	12	450
Premium Gem	Kinny	May 18	May 23	June 18	July 8	51	July 23	15	445
Tom Thumb	Kinny	May 18	June 2	July 2	July 23	66	Aug. 9	17	557

Descriptive Notes on Corn.

Chicago Market,— Early; dwarf, four feet high; ears five inches long, twelve-rowed, kernels large; quality, No. 3.

Durkee Sweet.— Early; dwarf, three and a half to four feet high; ears eight inches long, kernels large; quality, No. 1.

Honey Sweet.— Early; five and a half to six feet high; ears eight inches long, large kernel; stalks dark red; leaves tinged with same.

Livingston's Gold Coin.— Late; seven and a half to eight feet high; ears nine to ten inches long, fourteen to sixteen-rowed; lemon yellow when about to glaze; quality, No. 2.

New Queen.— Very early; dwarf, four feet high; ears five to six inches, eight-rowed, kernels large; stalks, reddish tinge; quality, No. 2.

Perry's Hybrid.— Early; five to five and a half feet high; ears eight inches long, kernal large, well set, ten-rowed.

The results of observation of the different varieties of corn grown are presented in the following table:

CORN.	Seed from	Date planted.	First vegetation.	First edible maturity.	Days from planting.
Chicago Market	D. of A.	May 9	May 17	August 7	90
Durkee's Sweet	Greg	May 9	May 18	August 5	88
Honey Sweet	Greg	May 9	May 18	August 5	88
Livingston's Gold Coin	Vick	May 9	May 18	August 25	108
Livingston's Gold Coin	Greg	May 9	May 18	August 25	108
New Queen	....	May 9	May 18	July 27	79
Perry's Hybrid	Thor	May 9	May 18	August 5	88
Stowell's Evergreen	Thor	May 9	May 18	August 23	106
Wine Streak	Jones	May 15	May 27	August 23	100
No. 4 Evergreen	Jones	May 15	May 26	August 24	101
No. 90 Early Evergreen	Jones	May 15	May 26	August 22	99

POTATOES.

A Test of Varieties.

The following table will show the yield of the several varieties from an equal amount of seed, one pound being used except when noted; and the yield given in pounds. The seed was cut to make twenty pieces, and two pieces planted in each hill, making ten hills of every variety. To make the conditions similar, parts of two plats were used, 292 feet of H and 237 of I plats, complete fertilizer being used at the rate of 200 pounds per acre. It was the intention to harvest the different varieties when ripe, but as the potato blight made its appearance early in July, it was thought best to leave the early varieties to be harvested with the late ones, in order to determine their rot resisting qualities, and although the accompanying table gives the per cent of decay of each variety it does not follow that the ratio would be maintained for a series of years, even if the conditions were identical. It is claimed that tubers that have been exposed to the disease should not be planted, as the germs may be present without developing any visible characters. But this season shows that although tubers may have been exposed to the influence of the rot it does not follow that they are affected. In the case of Bliss' Triumph, a variety grown with eighty others at the Vermont Station in 1888, it being the only variety that was badly affected, while tubers of that variety sent to this station from there this spring, developed plants that were among the very few that resisted the mildew, although the conditions were perfect for its fullest development.

POTATOES.

	Seed from	Date planted.	First vegetation.	Harvested.	Whole number tubers.	Weight of merchantable tubers.		Weight of small tubers.		Total weight.		Per cent tubers decayed.
						Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	
Arthur's Memorial	Crane	May 2	May 18	August 28	82	8	8	3	8	12	0	0
Advance	Vermont Station	May 2	May 20	August 28	60	7	12	3	8	11	4	16.7
American	Station	May 2	May 20	August 28	71	14	8	2	0	16	8	5.6
Alligator	Raw	May 2	May 18	August 28	91	....		5	8	5	8	0
Arundel Rose	Station	May 2	May 20	August 28	100	12	8	5	8	18	0	27.0
Brooks No. 1, 10-ounces	Emory	May 2	June 3	August 28	32	1	8	2	0	3	8	0
Brooks No. 2, 8-ounces	Emory	May 2	May 18	August 28	54	4	0	2	4	6	4	3.7
Badger State Peachblow	Crane	May 2	May 20	August 28	102	9	8	4	4	13	12	10.0
Beauty of Beauties	Vermont Station	May 2	May 18	August 28	130	14	12	12	12	25	8	34.0
Burbank's Seedling	Vermont Station	May 2	May 24	August 28	78	14	12	9	0	23	12	33.0
Bliss' Triumph	Vermont Station	May 2	May 18	August 28	92	10	8	5	4	15	12	0
Brownell's Best	Vermont Station	May 2	May 21	August 28	96	23	0	6	4	29	4	11.8
Brownell's No. 5	Station	May 2	May 20	August 28	38	2	0	4	8	6	8	0
Brown Beauty	Station	May 2	May 16	August 28	94	6	4	5	0	11	4	0
Brownell's Seedling	Station	May 2	May 17	August 28	127	15	8	4	12	20	4	0
Baraboo White	Station	May 2	May 20	August 28	41	2	4	2	0	4	4	0
Buffalo Bill	Station	May 2	May 15	August 28	72	3	12	3	0	6	12	7.0
Beauty of Hebron	Vermont Station	May 2	May 14	August 28	79	12	0	2	8	14	8	7.9
Blue Farmer	Benn	May 2	May 24	August 28	91	13	8	3	8	17	0	8.7
Cow Horn	Vermont Station	May 2	May 20	August 28	101	10	12	2	0	12	12	0
Clark's No. 1	Vermont Station	May 2	May 18	August 28	98	8	4	3	8	11	12	43.6
Charter Oak	Vermont Station	May 2	May 20	August 28	118	11	0	4	0	15	0	1.7
Crown Jewel	Station	May 2	May 20	August 28	83	9	4	2	8	11	12	28.9
Canada Prince Albert	Station	May 2	May 20	August 28	87	6	4	2	12	9	0	27.6
Corona Beauty	Thor	May 2	May 21	August 28	78	11	0	3	8	14	8	10.3
Crane's June Eating	Station	May 2	May 16	August 28	111	8	0	4	4	12	4	16.2
Charles Downing	Station	May 2	May 20	August 28	120	11	0	4	8	15	8	6.7
Coy's No. 88	Station	May 2	May 25	August 28	84	13	12	6	8	20	4	21.4
Dictator	Vermont Station	May 2	May 17	August 28	78	11	0	5	4	16	4	20.5
Dakota Red	Vermont Station	May 2	May 20	August 28	106	20	12	4	0	24	12	1.9
Dakota White	Station	May 2	May 24	August 28	79	6	8	3	8	10	0	2.5
Defiance	Station	May 2	May 20	August 28	96	15	4	8	12	24	0	21.9
Delaware	Station	May 2	May 20	August 28	80	20	0	2	8	22	8	3.8
Diehl's Eureka, 8-ounces	Benn	May 2	May 17	August 28	41	5	8	2	8	8	0	4.8
Early Maine	Vermont Station	May 2	May 20	August 28	94	11	8	5	0	16	8	17.0

Early Gem	Vermont Station	May 2	May 16	August 28	94	14	8	3	8	18	0	21.3
Early Mayflower	Vermont Station	May 2	May 20	August 28	115	12	2	4	12	16	14	5.2
Early Rose	Vermont Station	May 2	May 20	August 28	112	16	8	4	12	21	4	8.9
Early Essex	Vermont Station	May 2	May 18	August 28	105	9	8	8	8	18	0	29.5
Early Electric	Vermont Station	May 2	May 20	August 28	50	9	12	6	4	16	0	32.0
Early Washington	Vermont Station	May 2	May 20	August 28	112	6	12	7	8	14	4	8.9
Early Modena	Station	May 2	May 20	August 28	96	9	12	4	4	14	0	7.3
Early Puritan	Station	May 2	May 20	August 28	89	12	0	5	4	17	0	12.4
Early Ohio	Station	May 2	May 20	August 28	57	8	8	3	4	11	12	17.6
Early Red	Hallock	May 2	May 17	August 28	82	7	12	4	8	12	4	15.9
Early Market	Vick	May 2	May 23	August 28	53	7	12	4	8	12	4	22.6
Early White Ohio, 5-ounces	Dav	May 2	May 16	August 28	43	5	12	1	8	7	4	9.1
Early Thoroughbred	Dav	May 2	May 20	August 28	41	7	12	1	8	9	4	2.4
Early Dunham	Station	May 2	May 20	August 28	74	8	0	5	12	13	12	10.8
Early Albino	Station	May 2	May 20	August 28	78	6	4	3	12	10	0	7.7
Early Eclipse	Station	May 2	May 16	August 28	143	12	4	7	4	19	8	4.9
Early Standard	Station	May 2	May 22	August 28	94	11	0	4	4	15	4	34.0
Early Oxford	Station	May 2	May 17	August 28	76	6	8	5	12	12	4	30.3
Early King	Station.	May 2	May 20	August 28	77	10	4	5	0	15	4	27.3
Extra Early Vermont	Vermont Station	May 2	May 17	August 28	88	4	0	7	0	11	0	56.8
Empire State	Vermont Station	May 2	May 20	August 28	104	18	0	3	8	21	8	9.6
Excelsior	Vermont Station	May 2	May 20	August 28	110	10	8	4	8	15	0	11.0
Everett	Vermont Station	May 2	May 23	August 28	78	7	12	4	8	12	4	25.6
Early Sunrise	Vermont Station	May 2	May 17	August 28	93	8	12	5	0	13	12	41.9
Early New Zealand	Benn	May 2	May 23	August 28	79	7	8	3	8	11	0	18.9
Farina	Vermont Station	May 2	May 17	August 28	128	8	4	7	0	15	4	11.7
Gregory's No. 1	Vermont Station	May 2	May 16	August 28	91	7	8	6	8	14	0	43.9
Gold Fleshed	Vermont Station	May 2	May 21	August 28	101	7	12	6	0	13	12	12.9
Great Eastern	Vermont Station	May 2	May 20	August 28	51	4	8	2	0	6	8	3.9
Green Mountain	Station	May 2	May 17	August 28	102	18	8	6	12	25	4	10.8
Gov. Foraker	Station	May 2	May 17	August 28	92	16	0	2	0	18	0	4.3
Gen. McClellen	Station	May 2	May 16	August 28	88	11	8	4	8	16	0	10.2
Hampden Beauty	Station	May 2	May 20	August 28	99	13	0	5	8	18	8	13.2
Hall's Peachblow	Vermont Station	May 2	May 21	August 28	46	9	4	....		9	4	0
Howe's Premium	....	May 2	May 20	August 28	41	3	8	1	4	4	12	0
Imperial Irish Cup	Vermont Station	May 2	May 20	August 28	141	13	12	3	8	17	4	1.4
Irish Champion	Vermont Station	May 2	May 20	August 28	91	12	12	6	4	19	0	24.2
Junkis	Vermont Station	May 2	May 20	August 28	100	12	8	6	12	19	4	39.0
J. G. Blaine	Station	May 2	May 16	August 28	80	10	12	5	0	15	12	33.8
King's Excelsior	Station	May 2	May 20	August 28	84	15	0	3	0	18	0	3.6
Late Hebron	Vermont Station	May 2	May 18	August 28	117	19	0	7	0	26	0	17.9
Lee's Favorite	Vermont Station	May 2	May 16	August 28	103	15	12	4	4	20	0	15.5
Lake Erie	Station	May 2	May 21	August 28	79	12	12	3	0	15	12	6.3
Lombard	Station	May 2	May 20	August 28	91	10	0	7	12	17	12	34.1
Morning Star	Station	May 2	May 20	August 28	111	17	0	3	8	20	8	9.1
Monitor	Station	May 2	May 20	August 28	75	7	0	6	0	13	0	24.0
Mrs. Foraker	Station	May 2	May 20	August 28	96	7	12	4	12	12	8	22.9
Mooer's Dakota	Station	May 2	May 22	August 28	45	1	0	2	4	3	4	8.9
Morrell's Seedlings	Station	May 2	May 20	August 28	41	3	12	1	12	5	8	19.2
Mullally	Vermont Station	May 2	May 17	August 28	78	13	12	3	4	17	0	10.3

POTATOES — (*Continued*).

	Seed from	Date planted.	First vegetation.	Harvested.	Whole number tubers.	Weight of merchantable tubers.		Weight of small tubers.		Total weight.		Per cent tubers decayed.
						Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	
Monroe County	Vermont Station	May 2	May 17	August 28	91	9	4	8	0	17	0	21.9
Manhattan	Vermont Station	May 2	May 21	August 28	80	9	12	4	8	14	4	26.3
Matchless	Vermont Station	May 2	May 21	August 28	77	4	12	3	4	8	0	15.6
Nott's No. 8 (Mrs. Cleveland)	Vermont Station	May 2	May 16	August 28	97	13	8	3	0	16	8	8.2
New Wideawake	Station	May 2	May 21	August 28	123	12	8	3	4	15	12	4.1
New Queen	Station	May 2	May 21	August 28	96	13	4	4	12	18	0	9.4
New Queen	Greg	May 2	May 21	August 28	100	11	4	3	0	14	4	2.0
Nogal	Station	May 2	May 16	August 28	99	11	4	3	4	14	8	2.0
Norway Mt. Rose	Station	May 2	May 20	August 28	93	10	2	2	4	12	8	1.1
No. 50, 14-ounces	Fra	May 2	May 24	August 28	80	7	4	2	12	10	0	16.3
No. 64	Fra	May 2	May 20	August 28	71	8	4	2	0	10	4	1.4
Ohio Centennial	Station	May 2	May 20	August 29	21	....		1	0	1	0	4.8
O. K. Mammoth	Vermont Station	May 2	May 16	August 29	85	14	8	2	0	16	8	8.2
Old White Carter	Vermont Station	May 2	May 20	August 29	47	7	0	1	8	8	8	4.1
Ohio Junior	Station	May 2	May 18	August 29	40	5	4	1	0	6	4	11.6
Ontario	Station	May 2	May 15	August 29	61	4	8	1	8	6	0	6.1
Purple Blush	Vermont Station	May 2	May 20	August 29	79	12	8	2	8	15	0	10.1
Putnam's Beauty	Vermont Station	May 2	May 16	August 29	99	6	0	3	4	9	4	4.0
Putnam's New Rose	Vermont Station	May 2	May 16	August 29	89	15	4	1	8	16	12	12.1
Putnam's Early	Vermont Station	May 3	May 16	August 29	110	9	0	5	4	14	4	25.5
Putnam's Select	Vermont Station	May 3	May 16	August 29	90	8	8	4	12	13	4	1.0
Putnam's Favorite	Station	May 3	May 16	August 29	120	11	8	6	0	17	8	3.4
Pride of Palestine	Vermont Station	May 3	May 20	August 29	90	7	0	4	8	11	8	28.8
Polaris	Station	May 3	May 18	August 29	110	9	12	5	8	15	4	16.4
Perfect Gem	Vermont Station	May 3	May 17	August 29	97	13	8	5	12	19	4	12.6
Peruvian	Station	May 3	May 17	August 29	65	3	0	3	8	6	8	41.3
Pecan	Vermont Station	May 3	May 17	August 29	160	15	8	4	0	19	8	6.8
Pecan	Station	May 3	May 16	August 29	128	9	12	6	12	16	8	3.5
Queen of Valley	Vermont Station	May 3	May 16	August 29	93	8	8	5	4	13	12	32.1
Queen of Roses	Vermont Station	May 3	May 17	August 29	101	18	0	1	12	19	12	0
Rural, N. Y., No. 2	Station	May 3	May 20	August 29	38	6	8	1	0	7	8	0
Rural Blush	Vermont Station	May 3	May 20	August 29	91	22	4	1	4	23	8	0
Bochester Favorite	Vermont Station	May 3	May 17	August 29	113	12	0	4	12	16	12	41.6
Randall's Beauty	Vermont Station	May 3	May 17	August 29	116	22	4	1	12	24	0	0
Stump of the World	Station	May 3	May 21	August 29	55	7	8	1	0	8	8	9.5

Sunlit Star	Station	May 3	May 16	August 29	116	14	12	4	8	19	4	22.4
Snow Queen	Vermont Station	May 3	May 17	August 29	113	13	12	2	12	16	8	1.8
Snow Queen	Station	May 3	May 17	August 29	115	14	4	5	14	19	8	8.7
Sibley's Monroe County Prize	Station	May 3	May 20	August 29	91	16	8	1	0	17	8	1.9
Sylvan	Station	May 3	May 21	August 29	77	11	8	3	4	14	12	6.4
Seneca Red Jacket	Vermont Station	May 3	May 16	August 29	103	26	4	1	0	27	4	0
Stray Beauty	Vermont Station	May 3	May 20	August 29	138	8	4	5	8	13	12	1.6
Sagadahac, No. 1	Emory	May 3	May 20	August 29	151	6	4	4	4	10	4	0
Sagadahac, No. 2	Emory	May 3	May 20	August 29	63	3	4	2	4	5	8	4.4
Thorburn	Vermont Station	May 3	May 16	August 29	134	14	8	5	0	19	8	8.2
Thorburn	Station	May 3	May 16	August 29	89	17	4	1	0	18	4	9.1
Thunderbolt	Station	May 3	May 16	August 29	88	10	12	2	4	11	0	6.7
Tyrian Purple	Station	May 3	May 18	August 29	97	8	4	3	0	11	4	2.6
Vermont Champion	Vermont Station	May 3	May 15	August 29	106	23	4	3	0	26	4	7.5
White Burmuda	Station	May 3	May 15	August 29	74	11	0	4	12	15	12	13.5
White Beauty	Station	May 3	May 16	August 29	87	11	12	4	8	16	4	26.4
White Whipple	Station	May 3	May 20	August 29	70	7	0	2	0	9	0	24.2
White Beauty of Hebron	Vermont Station	May 3	May 20	August 29	95	11	8	4	8	16	0	26.1
White Beauty of Hebron	Station	May 3	May 15	August 29	68	6	4	2	4	8	8	16.4
Wood Ants	Vermont Station	May 3	May 20	August 29	95	9	0	2	12	11	12	10.2
Wall's Orange	Vermont Station	May 3	May 17	August 29	104	11	4	4	0	15	4	5.8
Windsor, No. 1	Station	May 3	May 17	August 29	100	7	12	5	0	12	0	6
White Seneca	Hunt	May 3	May 16	August 29	105	11	4	4	8	15	12	1.9
White Flower	Station	May 3	May 20	August 29	96	12	4	4	0	16	4	5.2
Yosemite	Station	May 3	May 20	August 29	65	10	12	1	8	12	4	3.5
Zenith	Crane	May 3	May 21	August 29	20	1	8	1	0	2	8	0
Seedling from Angle	Angle	May 3	May 20	August 29	45	5	8	1	0	6	8	0
Baldridge's Seedling	Bald	May 14	May 28	August 29	83	15	8	2	12	18	4	3.5
Rust Proof, 12-ounces	Jones	May 14	June 6	August 29	81	7	8	2	12	10	4	0
No. 76, 8-ounces	Jones	May 14	June 4	August 29	74	5	12	3	4	9	0	14
Fuller's Seedling, 5-ounces	Coolidge	May 29	June 14	August 29	40	8	4	1	0	9	4	1.5

SWEET POTATOES.

	Seed from	Planted in hot-bed.	Trans-planted.	Harvested.	Estimated yield per acre.	Per cent water.
Southern Queen	Plant*	April 20	May 10	October	187.6 bushels	71.80
Spanish Red	Plant	April 20	May 10		359.1 bushels	77.52
Yellow Nansemond	Plant	April 20	May 16		237.8 bushels	75.43
Red Nansemond	Plant	April 20	May 17		201.7 bushels	75.37

*Plant Seed Co., St. Louis.

A TRIAL OF SWEET POTATOES.

Tubers of the sweet potato were planted in a hot-bed and the sets transplanted on May thirteenth and twentieth. The ground in which they were planted lay to the south, and, although containing but little sand, is a light soil. Ridges of mellow soil were thrown up to the height of from twenty-four to thirty inches, the sets planted on the top of the ridges, at a distance of fifteen inches apart, and, although the season has not been favorable, they have exceeded our expectations, and proved beyond a doubt, that a paying crop of this excellent vegetable may be raised in this section. The failures in the past seems to have been that the sets have been shipped from the south and arrived in a wilted condition and planted, whether the conditions were favorable or not. Anyone can raise their own sets by making a hot-bed about the middle of April, and when the heat has receded to 70° or 75° F., cover the manure with three or four inches of good garden soil. Place the tubers on the soil, setting them down well, then cover about one-half inch above the tubers with light soil, leaf mulch, decayed hops or wood dirt, wet the bed well and cover with sash. No attention need be given, except to air them, until the young sprouts appear. They should then be watered as often as needed, and should be of good size to set in from fifteen to twenty days. By care in pulling the sets there can be three crops of them taken from the same seed. They should be planted either before or after a shower, given good attention, and especially on light soil, they can be grown in paying quantities.

DESCRIPTION OF VARIETIES.

Southern Queen.—A large white variety, early and of good flavor.

Spanish Red.—Large; dull pink and red; late, medium quality.

Yellow Nansemond.—Long, slim; yellow; season medium; quality good.

Red Nansemond.—The same as the foregoing except in color.

CARROTS.

	Seed from	Planted.	First vegetation.	Harvested.
Giant Wiltshire	....	April 18	May 10	October 10
Paris Forcing	Vill	April 18	May 9	October 10

Giant Wiltshire.—From twelve to sixteen inches long, eight to ten inches in circumference; yellow with reddish cast; usually very symmetrical, grows with the upper one-fourth out of the ground.

Paris Forcing.—Three to five inches long, five to six inches in circumference, usually pronged and split; pinkish red; not a good keeper.

DESCRIPTION OF THE NEWER TOMATOES.

Tres Hative d'Plaine Terre (Vil.).— A French variety of recent introduction. Growth, vigorous; leaves, finely cut; fruits bright red, spherical, flattened at apex; smooth, medium, large; seven to nine cells; very solid; fruits usually have a short piece of stem on, when detached; very productive.

Haines' No. 64 (N., B. & G. Co.).— Growth, rank; foliage, dark green; fruits bright red and symmetrical, of medium size, four to seven-celled, well filled with seeds, solid.

Horsford's Prelude (Rawson).— Growth, weak; scant leafage; fruits irregular, from round to long, bright red, uniformly small, smooth, four-celled, many seeds, soft.

Lorillard.— Growth, very vigorous, but stocky; foliage, dark green; fruits round, flattened on end, usually five-celled; meat solid, fine flavor.

McCullom's Hybrid (Vick).— Growth, vigorous; foliage, dark green; fruits bright red, round, flattened on end, smooth, very solid, ripens evenly, good quality; late this year, but claimed by introducers to be early.

The following table presents the observations made during the season upon the different varieties under cultivation:

TOMATOES.	Seed from	Sown in hot-bed.	Trans-planted.	First bloom.	First edible maturity.	Number of days from sowing.
Tres Hative d'Plaine Terre	Vil	March 20	May 14	June 15	August 9	142
Autocrat	Sib	March 20	May 14	June 8	August 24	157
Dwarf Champion	Hen	March 20	May 14	August 1	August 15	148
Golden Queen	Thor	March 20	May 14	June 13	August 23	156
Haines No. 64	N., B. & G. Co	March 20	May 14	June 18	August 23	156
Ignotum		March 20	May 14	June 17	August 8	141
Horsford's Prelude	Rawson	March 20	May 14	June 17	August 8	141
Island Beauty	Hen	March 20	May 14	June 28	August 17	150
King of Earlies	Ely	March 20	May 14	June 15	August 13	146
Livingston's Perfection	Thor	March 20	May 14	June 18	August 12	145
Lorillard	Raw	March 20	May 14	June 27	August 28	161
McCullom's Hybrid	Vick	March 20	May 14	June 14	August 26	159
New Bay State	Bragg	March 20	May 14	June 25	August 23	156
New Amber Gem	Sib	March 20	May 14	June 27	August 26	159
President Cleveland	Far	March 20	May 14	June 8	August 17	150
Scovill's Hybrid	Vaughn	March 20	May 14	June 16	August 12	145
Volunteer	Hallock	March 20	May 14	June 18	August 12	145
Station Upright	Sta	March 20	May 14	July 1	August 2	135

A TEST OF TOMATO SEED.

An experiment started in 1883, to note the influence of seed from ripe and green fruits of the tomato, has been carried on to date.

The results each year being the same, the seed from green fruits producing plants of impaired vigor, but earlier to ripen fruits, which are small but abundant. The earliness seems to be caused by the scant foliage being but little obstruction to the sunlight, the fruits being exposed at all times. It may be that some of our medium late varieties, as Mikado or Dwarf Champion, plants with coarse heavy foliage, might be made considerable earlier by trimming out the foliage or by training on some cheap kind of trellis.

It has been said that the black rot of the tomato appears to flourish most on the more vigorous plants, and the same observations may apply as to the late ripening of the most vigorous, *i. e.*, the heavy foliage being a bar to the sunlight. The soil remains damp, which in very warm weather may make very favorable conditions for the development and spread of the disease germs. The subject will receive attention in the future.

In a test made this year of large and small fruits from the same plant of tomato, to ascertain the difference in productiveness, size and earliness, it was found that the seed from small fruits produced plants of but medium vigor and productiveness, but very early, and as large fruits as the plants from large fruits. The latter were more vigorous and productive, and ten days later to ripen fruits.

ONIONS.

The following table gives the results obtained with several varieties of onions cultivated this season:

ONIONS.	Seed from	Date planted.	First vegetation.	Tops dead.	Harvested	Yield merchantable.	Yield small.	Total yield.
						Pounds.	Pounds.	Pounds.
Early White Nocera	D. of A	April 9	April 29	....	Sept. 28	55½	3½	59
Early White Queen	D. of A	April 9	April 27	Aug. 10	Sept. 28	18¾	7½	26¼
Flat Maderia	D. of A	April 9	May 2	....	Sept. 28	69	4½	73½
Giant Blood Red Ricco	D. of A	April 9	May 1	....	Sept. 28	89¾	2½	92¼
Giant White Italian Trippoli	D. of A	April 9	April 29	....	Sept. 28	118¾	2½	121¼
Giant Yellow Globe Rocco	D. of A	April 9	April 29	....	Sept. 28	167¾	3½	171¼
Mammoth Pompeii	D. of A	April 9	April 30	....	Sept. 28	144½	3	147½
Mammoth Silver King	D. of A	April 9	April 27	....	Sept. 28	65½	4¾	7¼
New Adriatic Barlette	D. of A	April 9	April 29	Aug. 11	Sept. 28	25¾	6½	32¼
Round Maderia	D. of A	April 9	May 1	....	Sept. 28	158	2	160
Good Keeping Red (Rose and Bonne Gard)	Vil	April 9	April 30	....	Sept. 28	43½	3	46½
White Maggiojalo	D. of A	April 9	April 30	Aug. 10	Sept. 28	14	6	20

CABBAGES AND CAULIFLOWERS.

The following tables present the comparative results obtained in our tests of several varieties of cabbage and cauliflower:

CABBAGE.	Seed from.	Seed sown in frame.	Transplanted.	Number of days from sowing.	Harvested.	Number of days from transplanting.	Average weight.	Average diameter.
							Lbs.	In.
Henderson's Autumn King	Hen....	April 23	June 22	59	Oct. 26	126	7½	10
Hard Heading	Greg....	April 23	June 22	59	Oct. 26	126	5⅛	9
Improved Stone Head Red Dutch	Thor....	April 23	June 22	59	Oct. 26	126	4⅞	7½
Joseph Mason	Greg....	April 23	June 22	59	Oct. 26	126	4½	7
Late Flat Dutch	Hallock	April 23	June 22	59	Oct. 26	126	8¾	10⅞
Midsummer Savoy	Hen....	April 23	June 22	59	Oct. 26	126	2½	6¼
Schlitzer	Greg....	April 23	June 22	59	Oct. 26	126	5¾	8
Wick's Long Island Red	Hallock	April 23	June 22	59	Oct. 26	126	4¼	7

CAULIFLOWER.	Seed from	Seed sown in France.	Date transplanted.	Number of plants transplanted.	Days from sowing.	Edible maturity.	Days from sowing.	Harvested.	Number of heads harvested.	Average diameter per head.	Average weight per head.
										Inches.	Lbs.
Early Puritan......	Ferry	April 23	June 22	20	59	Aug. 21	119	Oct. 18	13	5½	5½
Early Erfurt	March ...	April 23	June 22	20	59	Aug. 22	120	Oct. 18	19	8½	5¼
Snow Ball........	March ...	April 23	June 22	20	59	Aug. 24	122	Oct. 18	20	7½	3
Vick's Ideal................	Vick......	April 23	June 22	20	59	Aug. 30	128	Oct. 18	20	7	2¾

The cauliflowers raised from seed sent us by H. A. March, Fidalgo, Washington, are interesting in showing that as good crops can be raised from home-grown seed as from imported, and it is said that seed grown in Washington can be sold for one-half what foreign seed cost to import.

LETTUCE.

The following table gives the observations made upon several varieties of lettuce grown the past season:

LETTUCE.	Seed from	Date planted.	First vegetation.	First edible maturity.	First ripe seed.
Buttercup*	Sta.	April 18	May 6	May 27	....
Everlasting	Everett	April 18	May 6	May 29	Aug. 21
Golden Ball*	N., B. &G. Co.	April 18	May 6	May 27	....
New Zealand	Hunt	April 18	May 4	May 31	Aug. 19
Market Gardener's Private Stock	Thor.	April 18	May 4	May 27	Aug. 23

* Not in seed when pulled up.

INSECTS, INSECTICIDES AND FUNGICIDES.

Injurious insects have not been as destructive to small fruits and vegetables this year as in the past, the continued rains of the early summer being, in my mind, one of the leading factors in diminishing their numbers.

The cucumber beetle made its appearance early in the season, and its ravages were quite extensive, causing a complete failure of the early-sown squash and pumpkins, the frequent showers washing off any and all applications as they were made. Lime, plaster and a mixture of plaster with London purple or Paris green were used at different times, but did not remain on the foliage a sufficient length of time to be eaten by the beetle.

The potato bugs were hand-picked until the young brood were hatched, after which London purple and water was twice applied, at the rate of six ounces to fifty gallons of water. This not being satisfactory, one application of Paris green in solution, four ounces to fifty gallons of water, was found sufficient.

The currant worm succumbed to from one to three applications of hellebore in water, one teaspoonful of hellebore to one gallon of water, using a Nixon pump and nozzle, the flexible rubber hose enabling one to thoroughly wet the under surface of the leaves. The advantages of using hellebore in water are economy, and the ability to distribute to all parts of the plant, also to apply it at any time, whereas by the old method of dusting the poison on, there was a large waste, and it was necessary to apply it while the dew was on, or to wet the foliage in order to hold it long enough to be consumed by the insects. Currant bushes that were top-dressed with iron filings in 1888, as a repellant of currant worms were the first to become infested by them, and they were very numerous before they were discovered on other bushes.

A potato beetle, found in a hot-bed on the Station grounds, infested with its parasite, *Uropoda Americana* (Riley), was placed in a glass tube and ten other beetles added. The tube was kept in a warm room, and examined at intervals. In four days six of the ten had a few of the parasites attached to them, but the original beetle had lost many more than had obtained a hold of the others, the remainder being in the tube apparently lifeless. In two weeks after, the parasites were all dead, and a few of the beetles.

Professor Lintner* says that after the parasite becomes detached from the beetle it soon dies, not being able easily to regain its position. As the parasite is found in most cases on beetles in hot-beds, it will be an interesting study to undertake the culture of them, but it is very doubtful if they can be increased in sufficient numbers to be of any practical value.

The spraying with potassium sulphide for mildew of the gooseberry has been continued this season with still more assured success. On May seventh, eight rows, each containing six plants, were operated on, four plants of each being sprayed, two of each being left for checks. The solution was one-half ounce potassium sulphide to one gallon of water, applied with a Nixon pump and nozzle. At this time the plants were entirely free from mildew. The second application was made May fifteenth, when the check plants showed slight signs of mildew. Again on the third of June they were sprayed, when the check plants were badly affected and continued so through the season, while those that were sprayed retained their usual vigor and bore smooth, clean fruit. To make a further trial, a row of Seedling Industry was taken containing thirty-five plants, each alternate plant being sprayed, and, although the plants were very close together, the sprayed ones could be easily distinguished from either end. Considering the cheapness of the remedy, the potassium sulphide in a cheap form costing about twenty-five cents per pound and one pound making thirty-two gallons of mixture, it would seem as if the culture of gooseberries might be made profitable again.

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*Cultivator and Country Gentleman, June 13, 1888, p. 456.

A DISEASE OF THE HOLLYHOCK.

In the latter part of May, there was found on the grounds of one of our leading nurserymen, hollyhocks infested with a disease new to this section. Samples were sent to Professor W. G. Farlow, Cambridge, Mass.; Professor W. R. Dudley, Cornell University, and Professor C. H. Peck, Albany, N. Y., all of whom pronounced it the true hollyhock blight (*Puccinia malvacearum*). Professor Farlow records its appearance in this country in 1886, and its introduction traced to seeds imported from Europe, in which country it made its appearance between 1870 and 1875, and spread to such an extent that in many places the cultivation of the hollyhock was for a time abandoned.

The seed from which the affected plants were grown in the aforesaid nurseries, was bought of a seed firm who, presumably, imported direct from some point in Europe. The disease attacked the plants on the Station grounds that were grown from seed raised here, and as we are at least one-fourth of a mile from those in the nurseries, it is difficult to tell whence it came, unless the spores of the fungus were carried by the wind. The only efficacious remedy known is the total destruction of the plant by burning. Professor Peck suggested the application of Bordeaux mixture or any of the fungicides used against grape fungi. There has been tried at the Station the mixture used for gooseberry mildew, sulphide of potassium, and a solution of one-fourth of a pound of salt to two gallons of water, but with no marked success. It is to be hoped that a remedy may be discovered for this disease, as the loss of this stately garden favorite would be felt the world over.

TEST OF PLANT PROTECTOR.

The Station received in the spring of 1889 from Sherman & Crouch, Sidney, N. Y., a patent plant protector, a very simple affair made of four flat stakes sharpened at one end, with prepared cloth tacked on the sides and top and two thin pieces of wood to fit between the stakes when open to keep the protector rigid. They are of great utility in protecting plants of the cucurbit class from the ravages of insects, the larger size also for protecting early tomatoes, egg plants, etc., and if they can be furnished at prices that will enable market gardeners to use them, they should come into general use.

REPORT OF THE ACTING POMOLOGIST.*

The work reported covers the time between April 1 and November 1, 1889, and has been for the most part a continuation of that already commenced in the testing of new fruits (as outlined in Bulletin No. 15 of the Station, sent out in 1888, and referred to in the report of the horticulturist for the same year), and work tending toward the improvement of the orchards. This, with the other routine work performed, has left little time for experimental work.

The work reported is divided as follows :

Care and improvement of the orchard.
Notes on fruits.
Lists of varieties.
Spraying the orchards with insecticides.
Spraying with fungicides.
Plums eaten by the curculio.
The aphideæ, spraying with clear kerosene and emulsion.
Seed selection, with notes on vegetation.

ORCHARDS.

The apple orchards were thoroughly pruned during the month of April. Although more or less pruning has been done in the orchards in each year since the establishment of the Station, very many superfluous limbs were still left, especially so in the old orchard, interfering with the free use of the teams in cutting and drawing the hay, and other necessary work with teams. These limbs were removed and the tops thinned out to admit the sun and air to the fruit. The young orchard has been largely top-worked to new varieties and older ones deemed worthy of trial, commencing in 1886 and continuing in 1888–89. The tops of these were also thinned out, and the cross limbs and those affecting the symmetry of the trees removed. The trunks of all were then scraped, removing the old bark, and then washed with a solution of whale oil soap and carbolic acid. The soap was placed in a large kettle filled with water, and boiled until the whole was thoroughly emulsified. After cooling, it was diluted with water, the acid added, and the wash was then applied to the trunks of the trees and largest branches with old whitewash brushes. This improved the appearance of the trees, and doubtless destroyed many eggs and the larva of insect pests hidden under the rough bark and in the crevices of the trees.

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* G. W. Churchill

PEAR.

The pear trees were not shortened in the tops, and only such limbs removed as were growing across the trees. or in cases where the tops were thought to be growing too compact for a perfect maturity of the fruit.

PLUM, PEACH, APRICOT AND NECTARINE.

Half of the growth of the previous year was cut off and the cross limbs taken out. By the shortening in of the tops, the tree is made to grow more compact, and it is thought it will also bring the bearing surface nearer the body of the tree by causing fruit buds to form nearer the base of the limbs, thereby lessening the danger of the limbs breaking down when burdened with fruit.

FERTILIZERS APPLIED.

The apple orchards have been in grass since the spring of 1883, and a crop of hay cut every year with the exception of 1885, when the old orchard was summer fallowed to destroy the wild parsnip and other weeds. The following spring it was sown with oats and again seeded. A crop of hay has been cut each year since. But very little fertilizer was applied during this time, and that in the form of commercial phosphates, the grass, no doubt, receiving the main benefit, to the detriment of the trees and fruit.

The pear, plum, peach, and orchards of miscellaneous fruits have been kept in cultivation. Small fruits and garden crops have been grown between the rows of fruit trees. These have received manures of different kinds and in varying quantities, so it is impossible to give any idea as to the amount.

The past season all have received a dressing of Canada hardwood ashes applied at the rate of one ton to the acre, except in one case where cow manure mixed with sawdust from the experiment cow stable was substituted between two rows of apple trees.

In addition to this, the test apple orchard has received an application of tankage from the cisterns in the manure platform, containing the urine and wash from the experiment cow stables and piggery, but was found on analysis to be so dilute that probably little benefit will be derived from it, but it is proposed to continue the applications, as more liquid will be available during the winter, containing less water.

NOTES ON FRUITS.

APPLES.

The trees top-worked in 1883 have continued to make a vigorous growth. Nearly all blossomed and gave promise of a good crop. A large percentage of them have borne some fruit, but in nearly all cases of such an inferior quality that it is impossible to judge of their merits or to make any comparison of the relative value of the varieties. The following, comprising a very small number of the varieties, have produced a large crop of fine fruit:

Keswick Codlin.
Ben Davis.
Lord Suffield.
Small's Admirable.
Duchess.
Tetofsky.

We will not attempt an explanation of these facts, or advance a theory as to the probable cause, but many questions are suggested which we mean to take into account in the future care and study of the trees.

PEARS.

The Kieffer pear is the only one in addition to the varieties reported on last year that has borne a crop of fruit worthy of mention. The cions were top-grafted in 1883 on a seedling stock. Specimens of fruit have been gathered from it for two seasons past, and this year a half bushel of very fine fruit was picked from the tree on October ninth.

The fruit was of good size and free from injury of insects or fungi. When ripened it was very handsome in appearance, coloring to a bright golden yellow with a red cheek where exposed to the sun, quality very inferior. But with its many strong points, vigor of tree, earliness of bearing, and freedom from injury to fruit by disease or insects, it may become popular in the markets as a canning pear. And this, we think, is all that can be expected, as it seems unwise to place a pear of such qualities on sale as a dessert fruit.

The following varieties of pears have been killed by the pear blight: André Desportes, Beurre de l'Assumption, Duhamel du Moncean, Henri Desportes, Hoosic Madame André Leroy, President Mas and St. Crispin.

Peaches and Apricots.

The peach trees have made a very vigorous growth during the season of 1889, but of the varieties under comparative test none have borne fruit. Of the apricots a number of the varieties were found to be partially dead in the spring, the bark and wood was blackened, the greater discoloration showing in the north and west sides of the trees. They were carefully examined for traces of the borer, but as none could be found nor signs of any other injuries that could have caused their death, it was attributed to the effects of the winter. There is one circumstance in the life of the trees that would seem to make this possible even in a winter as mild as that of 1888. The ground had been heavily manured with farm-yard manure, stimulating the trees to an abnormal growth, and when winter set in, the young wood was not sufficiently hardened to withstand the winter. The following varieties have been killed as described above:

De Coulange.
Black.
Breda.
Early Golden.
Kaisha.
Moorpark.
Orange.
Canino Grosso.
Hemskirke.
Peach.
Red Muscatine.
Shipleys.
Tuskey.

Some of the varieties left blossomed but failed to set fruit.

Grapes.

The vines reported on were set from 1882 to 1887. The crop of fruit the present season has been small in all cases. No vine on the Station grounds has borne a full crop, some old varieties that are known to be productive not bearing at all, or if so, very imperfect fruit. This was mainly due to the unfavorable season, the cold, wet weather at the time of blossoming destroying in part the effect of the pollen. As a result the bunches were not properly filled out, making it impossible to describe the size or the shape of the bunches. The vines with but few exceptions have made a vigorous growth during the season, and while the vines and fruit in many of the vineyard sections of the State have been injured by fungus diseases, our vines at the Station have suffered but little. The downy mildew attacked a few of them, causing but slight damage to the fruit. The table annexed gives the data collected for the season.

	First leaves appeared.	First flowers opened.	Fruit ripe.	Last leaves falling.	Yield.	Growth.	Remarks.
Agawam	May 10	June 18	Sept. 14	*	Small	Vigorous	No mildew.
Amber Queen	May 10	June 15		*	Very small	Vigorous	Mildewed badly; fruit did not ripen.
August Giant	May 10	June 15	Sept. 10	*	Small	Feeble	No mildew.
Bacchus	May 7	June 9	Sept. 25	*	Small	Very vigorous.	No mildew.
Barry	May 9	June 15	Sept. 10	*	Very small	Very vigorous.	Traces of mildew.
Black Maderia	May 17	June 19		*		Very vigorous.	No mildew.
Brighton	May 9	June 15	Sept. 10	*	Very small	Very vigorous.	Traces of mildew.
Burnet	May 10	June 18		*		Vigorous	No mildew.
Catawba	May 10	June 15	Oct. 5	*	Fair	Vigorous	No mildew.
Centennial	May 12	June 16	Sept. 17	*	Very small	Feeble	No mildew.
Champion	May 10	June 15	Sept. 7	*	Small	Very vigorous.	No mildew.
Concord	May 14	June 19	Sept. 21	*	Very small	Vigorous	No mildew.
Duchess	May 10	June 18	Sept. 15	*	Small	Very vigorous.	Some mildew.
Early Victor	May 10	June 18	Sept. 15	*	Small	Very vigorous.	Traces of mildew.
Eaton	May 14			*		Very vigorous.	No mildew.
Empire State	May 10	June 18		*		Feeble	No mildew.
Emuelan	May 8	June 18	Sept. 4	*	Fair	Vigorous	Traces of mildew.
Green Mountain	May 9	June 15	Aug. 28	*	Good	Very vigorous.	No mildew.
Hayes	May 10	June 17	Sept. 12	*	Very small	Very vigorous.	No mildew.
Highland	May 20			*		Feeble	No mildew.
Iona	May 14	June 18	Sept. 22	*	Small	Vigorous	No mildew.
Isabella	May 10	June 15	Sept. 18	*	Very small	Vigorous	No mildew.
Jefferson	May 14	June 20	Oct. 9	*	Fair	Very vigorous.	Mildew on one bunch of fruit.
Jessica	May 9	June 15	Sept. 3	*	Fair	Vigorous	Some mildew.
Lady	May 15	June 15	Sept. 17	*	Fair	Vigorous	Some mildew.
Lady Washington	May 10	June 18	Sept. 25	*	Very small	Vigorous	Mildewed badly.
Lindley	May 10	June 15	Sept. 9	*	Fair	Very vigorous.	No mildew.
Mary	May 10			*		Feeble	No mildew.
Monroe	May 9	June 15	Sept. 7	*	Fair	Vigorous	No mildew.
Moore's Early	May 10	June 15	Sept. 6	*	Very small	Vigorous	No mildew.
Niagara	May 10	June 15	Sept. 10	*	Fair	Very vigorous.	No mildew.
Norwood	May 10	June 18		*	One bunch	Vigorous	No mildew.
Pocklington	May 13	June 15	Sept. 10	*	Fair	Feeble	No mildew.
Poughkeepsie	May 10			*		Feeble	No mildew.
Prentiss	May 10	June 15	Sept. 21	*	Fair	Vigorous	No mildew.
Rochester	May 17	June 15	Sept. 7	*	Small	Vigorous	No mildew.
Salem	May 8	June 15	Sept. 12	*	Very small	Vigorous	No mildew.
Senasqua	May 14	June 19		*		Vigorous	Mildewed badly.

Ulster Prolific	May 9	June 15	....	*	....	Weak	No mildew.
Vergennes	May 12	June 15	Sept. 12	*	Very small	Very vigorous.	No mildew.
Wilder	May 9	June 15	Sept. 12	*	Very small	Very vigorous.	No mildew.
Woodruff Red	May 9	June 15	....	*	....	Very vigorous.	No mildew.
Worden	May 15	June 16	Sept. 7	*	Very small	Very vigorous.	No mildew.
Seedling from J. G. Burrows	May 9	....	....	*	....	Vigorous	No mildew.
Seedlings from T. V. Munson:							
No. 17	May 12	June 18	Sept. 24	*	Fair...........	Vigorous	Traces of mildew.
No. 20	May 9	June 15	Sept. 15	*	Good...........	Vigorous	No mildew.
No. 20½	May 9	June 16	Sept. 15	*	Fair...........	Vigorous	No mildew,
No. 21	May 9	June 16	Sept. 15	*	Very good.....	Vigorous	No mildew.
No. 22	May 9	....	....	*	....	Vigorous	No mildew.
No. 24	May 9	....	....	*	....	Vigorous	No mildew.

* All varieties defoliated by frost between October fifteen and twenty,

THE TEST GRAPE VINEYARD.

The vines of which this vineyard is composed were set out in the spring of 1888. The board of control in the same season decided on a site for the new barn and cattle-yards, including in the area the ground occupied by the vines. This necessitated their removal early in the fall before the leaves had fallen and while the wood was green on many of the vines. Every effort was made to save the varieties by taking green wood cuttings for starting in the green-houses, and later hard wood for ordinary propagation. But with all the precautions taken a few varieties were entirely lost, while of many others only one vine has been preserved, and it is estimated that all received a check equal to a season's growth. None have borne fruit the present season.

In the following table the length of the season's growth is given with notes on the comparative health and vigor of the vines:

GRAPE—DATE AS TO GROWTH AND VIGOR.

	LENGTH OF GROWTH.		Condition of vine.
	Feet.	Inches.	
Adirondack	3	....	Vigorous, no mildew.
Aledo	3	2	Vigorous, no mildew.
Amber	3	7	Vigorous, no mildew.
Ambrosia	3	5	Vigorous, no mildew.
Arnold's No. 16	1	4	Vigorous, no mildew.
Beagle	3	....	Some rust on leaves.
Black Eagle	1	3	Appears vigorous.
Brighton	1	2	Appears vigorous.
Caywood, No. 50	3	8	Very vigorous.
Clevener	5	3	Very vigorous.
Clinton	2	8	Vigorous.
Cottage	2	3	Vigorous.
Creveling	....	8	Badly rusted.
Croton	2	....	Traces of mildew.
Daisy	2	10	Vigorous.
Delaware	....	....	No growth to speak of.
Diana	1	8	Vigorous.
Dracut Amber	1	8	Very vigorous.
Duchess	....	....	No growth to speak of.
Ea. Market	2	2	Vigorous.
Eldorado	3	6	Very vigorous.
Elsingburgh	1	1	Some rust.
Elvibach	4	....	Very vigorous.
Elvira	4	....	Very vigorous.
Etta	1	10	Vigorous.
Faith	4	4	Very vigorous.
Gaertner	....	8	Very weak.
Geneva	3	6	Vigorous, some rust.
Gov. Ireland	2	1	Vigorous, some rust.
Grayson	3	7	Vigorous.
Grenis Golden	6	....	Very vigorous.
Hartford	4	9	Vigorous.
Janesville	4	....	Vigorous.
Jewell	1	10	Weak.
Little Blue	....	....	Just alive.
Mabel	4	2	Vigorous.
Marion	4	10	Vigorous.

GRAPE — DATE AS TO GROWTH AND VIGOR — (*Concluded*).

	LENGTH OF GROWTH.		Condition of vine.
	Feet.	Inches.	
Massasoit	5	....	Very vigorous.
Maxatawney	1	3	Weak
Merrimac	1	5	Appears healthy.
Metterny	....	6	Weak.
Mo-Reissling	1	8	Appears healthy.
Monteflore	2	7	Vigorous.
Moore's Diamond	2	11	Vigorous.
Nectar	2	4	Vigorous.
Noah	3	6	Vigorous.
No. 15 (Stayman and Black)	4	10	Very vigorous.
Northern Muscadin	2	4	Broken off, very strong cane.
Olita	5	3	Very vigorous.
Pearl	3	6	Vigorous.
Perkins	3	5	Vigorous.
Poughkeepsie	1	3	Weak.
Profitable	5	8	Very vigorous.
Red Bird	3	7	Vigorous.
Red Eagle	4	3	Vigorous.
Rogers' No. 44	5	10	Very vigorous.
Rogers' No. 39	4	....	Vigorous.
Rogers' No. 32	3	5	Vigorous.
Rogers' No. 28	2	4	Slender canes.
Rogers' No. 24	3	8	Vigorous.
Rogers' No. 14	6	....	Very vigorous.
Rogers' No. 13	3	....	Vigorous.
Rogers' No. 5	3	6	Vigorous.
Rommel	2	7	Traces of mildew.
Roscoe	2	6	Vigorous.
Rustler	4	4	Vigorous.
Rutland	1	2	Fairly vigorous.
Standard	2	2	Vigorous.
Stayman's No. 19	....	....	Just alive.
Telegraph	1	2	Vigorous.
Triumph	....	11	Fairly vigorous.
Ulster	1	8	Vigorous.

LIST OF VARIETIES PLACED UNDER TRIAL PREVIOUS TO 1889.

APPLE.

Alexander.
Amasia.
Arctic.
August.
Aunt Ginnie.
Bailey Sweet.
Baldwin.
Ben Davis.
Benoni.
Blenheim Pippin.
Blood Red.
Brownlee's Russet.
Carolina June.
Canada Reinette.
Canada Baldwin.
Chicago.
Chenango.
Clark.
Cogswell.
Colvert.
Cooper's Market.
Cox's Pomona.
Dartmouth.
Delaware Winter.
Delaware Red Winter.
Dickinson.
Dominie.
Downing's Winter Maiden's Blush.
Duke of Devonshire.
Dumelow's Seedling.
Early Colton.
Early Harvest.
Early Ripe.
Early Strawberry.
Ella.
Esopus Spitzenburgh.
Ewalt.
Excelsior.
Fameuse.
Fanny.
Fallawater.
Fall Pippin.
Fall Wine.
Flora.
Gideon.
Gideon Sweet.
Golden Medal.
Golden Russet.
Golden Sweet.
Gravenstein.
Gracie.
Green Newtown Pippin.
Grimes Golden.
Haas or Fall Queen.
Hartford Rose.
Haskell Sweet.
Holland Pippin.
Hubbardston.
Hurlbut.
Indian.
Jacobs' Winter Sweet.
Jefferis.
Jersey Sweeting.
Jonathan.
Keswick Codlin
Lady Apple.
Lady Henniker.
Lady Sweet.
Landon.
Lankford.
Late Duchess.
Low.
Lord Nelson.
Lord Suffield.
Magog Red Streak.
Maiden's Blush.
Mann.
Martha.

McIntosh Red.
McMahan White.
Melon.
Menagere.
Milding.
Milligen.
Missouri.
Monmouth Pippin.
Montreal Pippin.
Montreal Beauty.
Mosher Sweeting.
Mother.
Munson's Sweet.
No. 1 Sweet (Gideon).
No. 2 Sweet (Gideon).
No. 3 Sweet (Gideon).
No. 30 (Gideon).
Nodhead.
North Western Greening.
Northern Spy.
Occident.
Ohio Beauty.
Ohio Pippin.
Oldenburg.
Ontario.
Palmer Greening.
Paul's Imperial.
Peach.
Peck's Pleasant.
Peter No. 6.
Pewaukee.
Picta Stricta.
Pomme Grisse.
Pound Sweet.
Primate.
Princess Louise.
Pumpkin Russet.
Pumpkin Sweet.
Rambo.
Rawle's Janet.
Red Astrachan.
Red Bietigheimer.
Red Canada.
Red Russet.
Reinette a feuille d'Aucuba.
Rhode Island Greening.
Reinette de Caux.
Rome Beauty.
Roxbury Russet.
Salome.
Sankermanky.
Schiawasse Beauty.
Scott's Winter.
September.
Small's Admirable.
Smith's Cider.
Sops of Wine.
Stark.
Stump.
St. Lawrence.
Summer Rose.
Sutton Beauty.
Swaar.
Sweet Bough.
Talman's Sweet.
Tetofsky.
Tobias Apple.
Tobias Black.
Tobias Pippin.
Tompkins' King.
Tuft's.
Twenty Ounce.
Vandevere.
Van Wyck.
Victoria Sweet.
Wagener.
Walbridge.
Washington Strawberry.
Wealthy.
Westfield Seek-No-Further.
White Pippin.
William's Favorite.
Winesap.
Winter Queen.

Wolf River.
Yellow Bellflower.
Yellow Forest.
Yellow Transparent.
York Imperial.

RUSSIAN.

Annarnoe.
Antonooskoe.
Aport Oriental.
Arabian, No. 184.
Astravaskoe.
Autumn Streaked, No. 9.
Babusschino, No. 469.
Belborodooskoe.
Belle de Boskoop.
Berkoff.
Bogdanoff.
Borsdorf, No. 341.
Charlottenthaler, No. 342.
Cut Wine, No. 210.
Count Orloff.
English Pippin, No. 507.
Enormous, No. 398.
Glass Green, No. 187.
Golden White, No. 978.
Grand Duke Constantine.
Grand Sultan.
Groskoe Selenke Grüner.
Heidvon, No. 164.
Howard's Aport.
Juicy Cream Tartar, No. 563.
Kalkidouskoe.
Karabowka.
Landsberger Reinette.
Longfield, No. 161.
Melonen, No. 568.
No. 7 (Gideon).
No. 21, Vorenesh.
Prolific Sweeting, No. 351.
Rash des Venskoe, No. 477.
Raspberry, No. 288.
Red Transparent.
Repka.
Restchestwenskoe.
Romenskoe, No. 599.
St. Peters, No. 372.
Scvitzer, No. 304.
Smelling Apple, No. 264.
Sugar Barbel, No. 368.
Summer Red Calville, No. 182.
Titouka.
Titus of Vorensh.
White Pigeon, No. 317.
Workaroe.
Zarskischip.
Zolototorreff, No. 275.

CRAB APPLE.

Coral.
Currant.
Hyslop.
Large Red Siberian.
Marengo.
Minnesota.
Oblong.
Red Siberian.
Transcendent.
Whitney's Seedling Siberian.
Yellow Siberian.

PEAR.

Angouleme.
Anjou.
Anna Nelis.
Ansault.
Bartlett.
Beacon.
Belle Lucrative.
Beurre de l'Assumption.

Bordeaux.
Bosc.
Boussack.
Brandywine.
Brignais.
Brockworth Park.
Buffum.
Clairgeau.
Clapp's Favorite.
Comet.
Comice.
Congress (Souvenir de Congress).
Craig.
Dana's Hovey.
De Lamartine.
Dearborn.
Directeur Alphand.
Dr. Hoskins.
Dr. Reeder.
Easter Beurre.
Fortune Boisselet.
Fondante de Bihorel.
Frederic Clapp.
Gans.
Gansel's Seckel.
Giffard.
Goodale.
Grand Isle.
Howell.
Jacques Molet.
Jones Seedling.
Josephine of Malines.
Jules Bivort.
Keiffer.
Lawson.
Lawrence.
Le Conte.
Little Gem.
Manning's Elizabeth.
Madame Appert.
Madame Millet.
Madame Treyve.
Marie Benoist.
Marshall.
Maurice Desportes.
Mount Vernon.
Osband's Summer.
Pitmaston Duchesse.
Pound.
Raymond de Montlaur.
Refreshing.
Rutter.
Seckel.
Sheldon.
Souvenir d'Esperen.
Summer Doyenne.
Superfin.
Theresa Appert.
Tyson.
Urbaniste.
Van Cott.
Winter Nelis.

Russian Varieties.

Bezi de la Motte.
Crassane Bergamotte.
Moscow, No. 4.
Peffer, No. 3.
No. 122.
No. 345.
No. 347.
No. 358.
No. 392.
No. 396.
No. 418.
No. 439.
No. 506.
No. 513.
No. 520.

PLUM.

Bavay's Green Gage.
Belle de September.
Botan.
Bradshaw.
Bryanston's Gage.
Burbank.
Coe's Golden Drop.
Copper.
Czar.
De Caradeuc.
Duane's Purple.
Early Orange Prune.
French Damson.
General Hand.
German Prune.
Golden Gage.
Goliath.
Grand Duke.
Green Gage.
Guii.
Hudson River.
Hudson River Purple Egg.
Huling's Superb.
Ickworth Imperatrice.
Imperial Gage.
Improved Green Gage, or Tobias Gage.
Italian Prune.
Jefferson.
Kingston.
La Fayette.
Lombard.
Lucombe's Nonesuch.
Mariana.
McLaughlin.
Middleburg.
Miner.
Monroe.
Moore's Arctic.
Niagara.
Newman.
Ogden.
Oullin's Golden.
Orange.
Peter's Yellow Gage.
Pond's Seedling.
Prince Englebert.
Prune d'Agen.
Prunus Simoni.
Quackenboss.
Robinson.
Royal Native.
Saint Lawrence.
Satsuma.
Seedling of Mariana, No. 1.
Seedling of Mariana, No. 2.
Shipper's Pride.
Shropshire Damson.
Smith's Orleans.
Speckled Gage.
Stanton.
Strawberry.
Transparent.
Union Purple.
Victoria.
Wangenheim.
Washington.
Weaver.
Wild Goose.
Yellow Egg.
Yellow Gage.

Russian Varieties.

Arab, No. 1.
Arab, No. 2.
Arab, No. 3.
Communia.
De Soto.
Hungarian.
Merunka.
Rollingstone.
Wolf.

CHERRY.

Arch Duke.
Brandywine Gem.
Bigarreau.
Black Eagle.
Black Tartarian.
Catskill.
Cleveland's Bigarreau.
Downer's Late.
Early Purple.
Florence.
Governor Wood.
Kentish.
Late Duke.
Leib.
Lithaner's Weichsel.
Louis Phillippe.
Luelling.
Lutovka.
May Duke.
Montmorency Large Fruited.
Montmorency Ordinaire.
Morello (English)
Murdock's Bigarreau.
Napoleon Bigarreau.
Reine Hortense.
Rostraver Bigarreau.
Schmidt's Bigarreau.
Sparhawk's Honey.
White Caroon.
Wragg.
Yellow Spanish.

PEACH.

Alberge Yellow.
Alexandra.
Amsden.
Beatrice.
Brevoort.
Chair's Choice.
Cooledge's Favorite.
Conkling.
Crawford's Early.
Crawford's Late.
Crockett's White.
Druid Hill.
Early Silver.
Early York.
Foster.
Garfield.
Goshawk.
Hale's Early.
Haine's Early.
Hill's Chili.
Kenrick's Heath.
Lady Ingold.
Large Early York.
Louise.
Magdala.
Malta.
Mrs. Brett.
Moore's Favorite.
Mountain Rose.
Myer's Seedling.
Nectarine.
Oldmixon Clingstone.
Oldmixon Freestone.
Princess of Wales.
Red Cheek Melocoton.
Reeve's Favorite.
River's Early York.
Rosier.
Royal George.
Salway.
Schumaker.
Steven's Rareripe.
Saunders.
Shanghai.
Snow Peach.
Stump the World.

Stevens' Late.
Surpasse Melocoton.
Thurber.
Wager.
Ward's Late.
Waterloo.
Willetts.
Wilder.
Wheatland.
Yellow St. John.

APRICOT.

Alexander.
Alexis.
Blenheim.
Catharine.
Early Moorpark.
Gibb.
J. L. Budd.
Large Early.
Large Early Montgamet.
Malcom's Breda.
Monthamet.
New Large Early.
Nicholas.
Orange.
Oullin's Early Peach.
Purple.
Royal.
Sardinian.
St. Ambroise.

QUINCE.

Champion.
D'Alger.
De Constantinople.
Rea.
Winter Sweet.

NECTARINE.

Boston.
Downton.
Early Newington.
Early Violet.
Elruge.
Lord Napier.
Newton.
Pitmaston Orange.
River's Orange.
Spencer.
Stanwick.
Victoria.

GRAPE.

Adirondack.
Agawam.
Aledo.
Amber.
Amber Queen.
Ambrosia.
Arnold's No. 16.
August Giant.
Bacchus.
Barry.
Beagle.
Black Eagle.
Black Madeira.
Brighton.
Burnett.
Catawba.
Champion.
Clevener.
Clinton.
Concord.
Cottage.
Creveling.

Croton.
Daisy.
Delaware.
Diana.
Dracut Amber.
Duchess.
Early Market.
Early Victor.
Eaton.
Eldorado.
Elsinburgh.
Elvibach.
Elvira.
Etta.
Empire State.
Eumelan.
Faith.
Francis B. Hayes.
Gærtner.
Geneva.
Grayson.
Green Mountain.
Grein's Golden.
Governor Ireland.
Hartford.
Highland.
Iona.
Isabella.
Janesville.
Jefferson.
Jessica.
Jewell.
Lady.
Lady Washington.
Lindley.
Little Blue.
Mable.
Marion.
Massasoit.
Maxatawney.
Merrimac.
Metterney.
Monroe.
Montefiore.
Mills.
Missouri Reissling.
Moore's Diamond.
Moore's Early.
Mary.
Marvin's Centennial.
Nectar.
Niagara.
Noah.
Norwood.
Northern Muscadine.
Norton.
Olita.
Oriental.
Pearl.
Perkins.
Pocklington.
Poughkeepsie.
Prentiss.
Profitable.
Red Bird.
Red Eagle.
Rochester.
Rommel.
Roscoe.
Rustler.
Rutland.
Salem.
Senasqua.
Standard.
Telegraph.
Triumph.
Ulster.
Ulster Prolific.
Vergennes.
Wilder.
Woodruff Red.
Worden.
Wyoming Red.

Seedlings not named.

From A. J. Caywood & Son: No. 50.

From D. S. Marvin:

No. 1.
No. 2.
No. 3.
No. 4.
Rogers' No 5.
Rogers' No. 13.
Rogers' No. 24.
Rogers' No. 28.
Rogers' No. 32.
Rogers' No. 39.
Rogers' No. 44.

LIST OF FRUIT VARIETIES ADDED TO THE TRIAL ORCHARD IN 1889.

APPLE.

Amos Jackson.
Andren Winter.
Arkansas Black.
Babbit.
Benninger.
Bright Water.
Celestia.
Clayton.
Coffelt Beauty.
Coons' Red.
Disharoom.
Dr. Walker.
Duncan.
Edwards.
Edwards Transparent.
Elgin's Pippin.
Etowah.
Everbearing.
Everbearing (Ill. Imperial).
Falix.
Family.
Family Favorite.
Ferdinand.
Farris.
Faust's Rome Beauty.
Hick's Sweet.
Jonathan of Buler.
July Cluster.
Kansas Greening.
Kittageskee.
Laucinburgh.
Longworth's Red Winter.
Loy.
Magnolia.
McKinley.
Mammoth Black Twig.
Moon.
Marshall's Red.
Nelson Sweet.
Olive.
Ornament de Table.
Osceola.
Parry White.
Pear or Palmer.
Pickard's Reserve.
Piper.
Pride of Texas.
Rhodes' Orange.
Rock Pippin.
Scarlet Cranberry.
Seedling Red Apple.
Shackleford.
Shaunon.
Shark Apple.
Spencer.
Stanard.

Stuart's Golden.
Topp's Favorite.
Van Hoy's No Core.
Water.
Wallace Howard.
Western Beauty.
White Doctor.
White Zurdel.
William Prince.

CRAB APPLE.

Cherry Red.
Gibb.
Looker Winter.
Richland Winter Sweet.
Sweet Russet.
Telfer Sweet.
Whitney, No. 20.
Winter Golden Sweet.

PEAR.

Arkansas Mammoth.
Bartseckle.
Chenilla.
Ching Sand.
Cincincis.
Cocklin.
Crow's Choice.
Downings.
Early Harvest.
Garber.
Garber Hybrid.
Idaho.
Japan.
Japan Gold Rust.
Longworth, No. 1.
Madam Von Seibold.
Mikado.
Victor.

PLUM.

Abundance.
De Sota.
Freestone Damson.
Forest Garden.
Forest Rose.
Garfield.
Golden Beauty.
Hoag's Seedling.
Honey Drop.
Kelsey.
Kelsey's Japan.
Kent.
Moreman.
Ogon.
Potawatamie.
Poole's Pride.
Prairie Flower.
Prunus Pissardi.
Quaker.
Robinson.
Spaulding.
Sweet Damson.
Wayland.
Wolf Free.
World Beater.

CHERRY.

Black Mastodon.
California Advance.
Dyehouse.
Early La Maurie.
Everbearing.
Ostheimer.
Ostheim.
Purity.

PEACH.

Caroline Beauty.
Catherine Cling.
Dr. McGill.
Fox's Seedling.
Henrietta Landon.
Millhisen.
Paul Boynton.
Pendleton.
Picquet's Late.
Prize.
Walker's Var-Free.
Wonderful.

APRICOT.

Golden Russian.
Skobeloff.

QUINCE.

Meeche's Prolific.

GRAPE.

Alice.
Black Defiance.
Cananicus.
Herald.
Hercules.
Hopican.
Isabella Seedling.
Jennie May.
Juno.
Magee.
Mills.
Mary's Favorite.
Mathilde.
No. 47, White.
Paradox Seedling, No. 502.
Winchell.

Native Wild Grapes of the United States.

This list includes many of the native species of the United States, which have been planted to furnish material for experiments in grafting and cross-fertilization with our named varieties, as they may be suggested in the future.

Vitis Aestivalis (Michx.).
Vitis Arizonica (Engelm.).
Vitis Berlandieri (Planchon).
Vitis Candicans (Engelm.).
Vitis Champini.
Vitis Cinerea (Engelm.).
Vitis Cordifolia (Michx.).
Vitis Doaniana (Munson).
Vitis Labrusca (of Mass.).
Vitis Linsecomii (Texas Post Oak Grape).
Vitis Munsoniana (Simpson).
Vitis Monticola (Buckley).
Vitis No. 32 Mills Co., Mont.
Vitis Riparia (Michx.).
Vitis Rutyndifolia (Michx.).
Vitis Rubra (Michx.).
Vitis Rupestris (Scheele).
Vitis Solonis (Engelm.).
Vitis Microsperma (Mun.).

SPRAYING THE ORCHARDS.

The past season has been in many respects very favorable to the life of insects infesting the larger fruits, the warm open winter allowing the eggs and larva to mature with a small percentage of loss by freezing, while the cold wet weather of spring and early summer retarded the first brood of the codling moth and extended the successive broods beyond the season when spraying can be done with a certainty of benefit.

The curculio was also held in check during the cold wet weather, but seemed to redouble its efforts to destroy the fruit later in the season.

The negative results obtained in the plum spraying experiments are, we think, in part explained by these facts.

The apple orchards were all sprayed the present season, except a few trees left as checks, a part of these were some distance from the main orchard and separated from it by one of the trial orchards of pear and plum trees, and by a railroad surveyed across a corner of the farm some years ago.

Prior to the present year no applications had been made in the test orchard with insecticides as a spray, for the destruction of insect pests injurious to the fruit. In the old apple orchard a number of trials had been made in different years, most of them to test the value of various poisons recommended for the purpose. Paris green and London purple were the only poisons that gave definite results. The orchards are thoroughly infested with the codling moth and curculio. Also during the season conceded to be the best for the destruction of these pests, rain fell almost incessantly, making it impossible to keep poison on the fruit and leaves long enough to be of benefit.

Spraying had to be continued at intervals as the weather would permit, making it impossible to spray the orchard in any number of consecutive days. The results obtained, however, show a paying percentage of benefit derived from the applications made for the codling moth.

The test plum orchard was sprayed with London purple and water, at the rate of one pound of purple to 200 gallons of water, for the curculio, it being the only available place for such experiments, the old plum orchard inclosed in the hen yards having been so little infested in other years that no work has been attempted in it. It was impossible to leave check trees, as there was no two trees of a variety in bearing. At the first spraying one side of some of the trees were left without spray, but they were so small that it proved impracticable and they were afterward sprayed. The first spraying was done on May fifteenth. At this time not all of the petals had fallen. Rain fell on the nineteenth, twentieth, twenty-first and twenty-fourth of the month, in all about .5 of an inch. The spraying was repeated on the twenty-fifth, ten days after the first application. Rain fell again on the twenty-seventh and thirty-first of May and on the first, fourth, fifth, sixth, eighth, ninth, tenth, eleventh and twelfth of June, the aggregate being 4.44 inches.

On the thirteenth of June the trees were sprayed for the third and last time. Rain again fell on the fifteenth, sixteenth, seventeenth, nineteenth, twenty-first, twenty-sixth and twenty-seventh of the month. Total for nine days 3.42, making a sum total of 8.36 inches from the time of the first spraying until the last of June, at such intervals as to destroy almost wholly the beneficial effects of the spray. As a result, almost the entire crop was lost, but two varieties, Shropshire Damson and Lombard, maturing a crop sufficient to be gathered, and a large number of fruits on these varieties were stung and fell off. The large number of fruits set rendered it impossible for the entire crop to be destroyed. If all the varieties in the orchard had set fruit equal to the two mentioned, a fair crop would have been obtained. This explains in a measure the fact that plum orchards sometimes bear large crops of fruit, greater often than is consistent with the future utility of the trees, without any precautions whatever having been taken for the destruction of insects.

From this experiment it seems unsafe to depend on spraying alone as a means of destroying the curculio in a season of excessive rainfall as it is impossible to keep poison on the fruit or leaves a sufficient length of time to be of appreciable benefit, and it would seem wise to combine spraying and jarring except in very dry seasons, until some better way can be devised for ridding the orchards of this pest. We would not, however, be understood as attempting to refute any of the experiments made by others, or the results of tests reported by other workers.

Without doubt, from the array of evidence recorded as to the beneficial results obtained by scientific workers in this field, great benefit has been and can be derived from the spraying of arsenites for the extermination of insects injurious to fruits, including the curculio.

SPRAYING FUNGICIDES.

But very little could be accomplished in this line of work the present season. Owing to the extended wet weather the applications made for the scab on the apple and pear gave negative results, and the only benefit derived was in spraying the grapes attacked with the downy mildew.

On June thirtieth this fungus made its appearance on the bearing vineyard. A spray of sulphide of potassium and water of the strength of one-half ounce of the sulphide to a gallon of water was applied to one-half of each vine. As the atmospheric condition seemed favorable to the growth of the fungus at the time when its first appearance was noticed, a rapid spread of the disease over the whole vineyard was looked for.

Such was not the case, however, and the greater part of the vines and fruit remained healthy. The application was repeated on July third, as rain fell soon after the first spraying, and the vines were treated for the last time on July tenth. As has been stated, observations were confined to a small percentage of the vines, but the benefits were marked in all cases where the disease fastened itself, amounting in some varieties to fifty per cent of the crop saved, that was attacked by the mildew.

TO WHAT EXTENT DOES THE CURCULIO EAT THE FRUIT?

In looking through the plum orchard, it was noticed that many of the fruits were disfigured by having one or more irregular holes or pits, eaten in the sides, supposed to be the work of the curculio. To verify this supposition and obtain more definite data in regard to the amount of injury that might be done by one individual, the experiment was made.

On June eleventh a curculio was placed in a bottle with a green plum and left until June fourteenth, when it was taken out and examined. It was found literally covered with the crescent-shaped marks indicating the presence of the eggs, and two holes had been eaten in the side of the fruit, very close together, either one of which was large enough to have buried the curculio out of sight.

Another plum was immediately put in place of the one removed, remaining until June seventeen and then examined, with about the same result as No. 1.

Next, two plums were put in the same bottle and left until the twenty-first; on being removed it was found that the curculio had deposited ten eggs in one, and eaten two holes, the larger of which measured .19 by .12 of an inch, and .1 of an inch deep, and the smaller .12 by .06 of an inch and about .07 of an inch deep. In the second nine eggs had been laid, but no part of the plum had been eaten.

These were replaced by another plum on the twenty-second; forty-eight hours after it was put in the bottle an examination showed eight eggs deposited and two holes eaten in the fruit, one .17 by .1 inch and .07 of an inch deep; the second .13 by .07 inch and .03 of an inch deep.

This was again replaced with a fresh fruit. This was taken out on the twenty-fourth, forty-eight hours intervening from the time it was put in, as in the last case cited. In it were found five eggs and a pit .23 by .13 inch, and .1 per cent of an inch deep. On the twenty-fourth, after removing the above, the seventh and last plum was put in the bottle. This was allowed to remain forty-eight hours and then removed on the twenty-sixth; in it were found eight eggs, and two places eaten out, one nearly round, .13 by .13 inch and .07 of an inch deep; the other .17 by .1 inch and .07 deep.

THE APHIDEÆ.

The wide spread distribution of the aphides, being found as they are on nearly every known tree and plant in the vegetable kingdom, with their many species, render them the most tenacious and at the same time destructive family of insects with which the horticulturist and orchardist has to deal. This is also pre-eminently true of the nurseryman, the suddenness of their appearance and the inconceivable rapidity with which they increase in number, make them a formidable enemy to him, costing, in the aggregate, thousands of dollars annually for labor in applying remedies and in the dwarfing, and, in many instances, the total destruction of his stock.

Nothing has yet been found which gives perfect satisfaction in destroying these pests, as many of the remedies cause almost as much damage as do the plant lice themselves.

Spraying seems to come short of accomplishing the desired end, as the habit of the aphis in curling the leaves, furnish them protection, and make it impossible to reach them with the spray in sufficient quantities to destroy them. This must be done if at all, while the trees have but little foliage, or are entirely dormant. It seems reasonable to believe that the eggs might be destroyed at this time in numbers sufficient to hold the aphis in check, by some liquid, in spray, which would not endanger the life of the tree. Another advantage would be the saving in liquid required to accomplish the work, and the saving of time also, as it could be done early in the season before the spring work has been fairly commenced.

To find if kerosene, either in emulsion, or in its pure state, would fill any of these requirements and to verify, if possible, some of the work already done, the following experiments were carried out.

EXPERIMENT WITH KEROSENE EMULSION.

An experiment was made with kerosene emulsion to test its efficiency in destroying the eggs of the apple aphis (*Aphis mali*). A twig of the previous year's growth was found on one of the trees in the young orchard, covered very thickly with the eggs of the aphis. It was cut as near the center as possible, and one section was then treated with a standard solution of kerosene emulsion, applied with an atomizing bellows with cup attachment, while the other section was left as brought from the tree. Each piece was then placed in a separate bottle, containing water enough to cover the base of the twig and keep it from drying. The bottles were kept in a warm room for several days, but as none of the eggs hatched they were moved to the green-house where the conditions were more favorable for the development of the eggs. On April fourth, eighteen days after the twig was taken from the tree, several well-developed specimens of the aphis were found on the section not treated with the emulsion, and they continued to increase in numbers as long as the twigs were kept in the house, whereas none were found on the section treated with the emulsion at any time. The result of this experiment seems to indicate that kerosene in dilute form will destroy the eggs if brought in direct contact with them.

CLEAR KEROSENE AS A SPRAY ON DORMANT TREES.

During the season of 1888 a few experiments were made by Mr. Goff with kerosene in its pure state, to note the effect on various trees and plants for the destruction of insect pests.

To verify these experiments and obtain additional data on the subject, if possible, the following experiments were made:

A row of old cherry trees south of the garden and running parallel with the apple orchard were taken in part for the experiment. The trees were planted some years previous to the establishment of the Station. Their age is therefore not known. They had been nearly destroyed by repeated attacks of the aphis and by severe pruning. Several of the large limbs were dead. Altogether they were in an unpromising condition. Three oils were used in the experiment, viz., a low flash oil furnished by the Shipman Engine Company of Rochester, N. Y., for use as fuel in their engine, water-white headlight oil, used for illuminating purposes, and crude petroleum. They were applied in the following order, with a small-sized Nixon pump and nozzle.

The first and second trees in the row were sprayed with the low flash oil, spraying being continued until the oil dropped from the trees, as in ordinary spraying. About one-half gallon of oil was used on each tree. The trees being dormant, accounts in a measure for the small amount of oil required to do the work. The third tree was sprayed with crude petroleum in the same manner as Nos. 1 and 2, but about double the quantity of oil was used owing to its being heavier and so much more viscous. The fourth tree was not sprayed, but was left as a check on the others.

Nos. 5 and 6 were treated with a spray of the second oil mentioned (white headlight), the same quantity being used as on Nos. 1 and 2, sprayed with the low flash oil.

Beside the experiments on the cherry, several apple trees in the old orchard were sprayed with the low flash oil. As stated in the beginning, the cherry trees taken for the experiments were not in a thrifty condition, and, as a consequence, some of the limbs have continued to die, and in one or two instances the trees are entirely dead. But I do not think that it is owing to the effect of the spray, for wherever the limbs appeared healthy, or, when used on vigorous trees, no injurious effects were noted.

The apple trees sprayed were in perfect condition, apparently, and they have borne a crop of fruit the present season, and are, as far as can be judged, at this time in perfect health. Although the experiments are not as definite in their results as was hoped for, we think the following conclusions may be safely drawn from them:

First. That kerosene can be used on many of our trees and plants when they are in a dormant state, without injury.

Second. That it will prove successful in destroying the eggs of the aphis and other insect pests, wherever it is possible to reach them with the spray.

Third. That it can be used at a nominal cost.

SEED SELECTION.

EXPERIMENT WITH BEANS, LARGE AND SMALL SEED.

When we consider the importance of the seed in the growing of any crop and the large amount of money expended by farmers and gardeners in our State alone in the purchase of seeds, annually, for the growing of farm and garden products, we see the importance of the selection of perfect seeds, and the great loss occasioned by the planting of worthless and impure seeds.

In 1887 an experiment was planned to cover a series of years testing the gain or loss in crop by the planting of selections of large and small seeds. It was intended to test a great number of field and garden seeds in this manner, but owing to the limited amount of time that could be given to the work, the experiments have been confined to one variety of bean. Golden Wax was selected, as it was thought by its earliness two crops might be grown in one season, and in this way secure two sets of experiments in the same year. The selection was unfortunate as but one crop could be matured, and as it is a garden variety and has never been bred for a field bean, the yield was very small compared with white beans grown for a shelled crop. It also proved very susceptible to disease, and the present summer quite a percentage of the crop was lost by a fungus disease which attacked the vines. But the results obtained from the trials are thought to be of sufficient interest to warrant their publication.

For the first year's experiment two quarts of Golden Wax beans were purchased from a miscellaneous lot found at one of the stores in the place. From these two sizes were selected and marked Nos. 1 and 2. For No. 1 the largest and finest beans were taken, and No. 2 was the smallest seed that could be found in the lot from which the seed was selected. All seeds appearing green or injured in any way were rejected.

The ground in which the seed was planted comprised two of a series of one-twentieth acre plats, G, 1 and 2, broken from a piece of meadow land in 1876. Instead of planting one plat to each of the selections made, the beans were planted in alternate rows, beginning with the large seed, then a row of small was planted, and this was continued, making the same number of rows of each planted on a plat, thus giving a more even distribution of the seed and eliminating in a measure the variations of soil. Care was also taken to plant the same number of hills in each row with an equal number of beans in each hill. There has been no fertilizer used on the ground under culture for the purpose of these experiments at any time in the three years named.

The plats were given ordinary field culture with horse and hand hoes, and when the crop matured each row was harvested and placed in a sack and numbered. They were then taken to the barn and hand threshed. Careful weights were taken before threshing of the total crop, and then of the beans. After repeated trials it was found impossible to weigh back the straw with any degree of accuracy, and the difference between the total weight and the weight of beans was taken for that of the straw. The table shows the results of the trials made in 1887.

EXPERIMENT WITH BEANS, LARGE AND SMALL SEED, 1887.

	SELECTED LARGE SEED. No. 1.			SELECTED SMALL SEED. No. 2.		
	Total weight.	Weight of beans.	Weight of straw.	Total weight.	Weight of beans.	Weight of straw.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
	2.09	1.28	.81	1.07	.68	.39
	1.78	1.10	.67	1.75	.95	.79
	1.89	1.01	.87	2.00	1.20	.79
	1.84	1.14	.70	1.40	.84	.56
	1.68	.96	.71	1.23	.78	.45
	1.79	1.10	.68	1.42	.84	.57
	2.04	1.21	.82	1.43	.87	.56
	1.75	1.06	.68	1.24	1.03	.60
Totals	14.89	8.90	5.98	11.96	7.21	4.75

From the data in this table we find that the large seed gave in total crop 2.93 pounds more than did the small seed or 19.6 per cent; in weight of beans 169 pounds or 18.9 per cent; and in weight of straw 1.23 pounds or 20.5 per cent; also that of the product grown from the small seed sixty per cent of the total weight of crop was beans and fifty-nine per cent of the total from the large seed, leaving forty-one per cent for straw of the large and forty per cent for straw in the crop grown from smal seed.

In 1888 the experiment was repeated and four selections made from the seed grown in 1887, viz., No. 1 from the largest beans grown from the large seed of the previous season, No. 2 was a selection of the largest beans grown from the small seed planted in 1887, No. 3 from the same lot of seed from which No. 1 was taken the smallest were selected, the smallest beans from the same seed from which No. 2 was selected were taken for No. 4. The seed from each was selected the same as in 1887, and care taken to have the separate lots as uniform as possible. Four one-twentieth acre plats were planted with these selections, G 1 and 2 planted in 1887 and to these were added the two adjoining plats on the east, G 3 and 4. The seed was planted and cared for as described in the first experiment of 1887. The tables give the total weights of crop, weights of beans and straw grown from each selection.

EXPERIMENT WITH BEANS, LARGE AND SMALL SEED, 1888.

	No. 1, SELECTED LARGE SEED GROWN FROM LARGE IN 1887.			No. 2, SELECTED LARGE SEED GROWN FROM SMALL IN 1887.			No. 3, SELECTED SMALL SEED GROWN FROM LARGE IN 1887.			No. 4, SELECTED SMALL SEED GROWN FROM SMALL IN 1887.		
	Total weight.	Weight of beans.	Weight of straw.	Total weight.	Weight of beans.	Weight of straw.	Total weight.	Weight of beans.	Weight of straw.	Total weight.	Weight of beans.	Weight of straw.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
	5.31	3.12	2.18	5.12	2.68	2.43	3.25	1.81	1.43	2.43	1.62	.81
	4.12	2.25	1.87	4.87	2.87	2.00	2.37	1.37	1.00	3.31	2.06	1.25
	4.68	2.87	1.81	3.81	2.18	1.87	2.75	1.75	1.00	2.37	1.75	1.62
	4.37	2.56	1.81	3.37	1.87	1.5	2.75	1.62	1.12	2.37	1.05	.87
	4.37	2.5	1.87	4.62	2.68	1.93	2.93	1.81	1.12	3.43	2.06	1.37
	5.43	3.31	2.12	5.87	3.25	2.62	4.00	2.43	1.56	3.56	2.25	1.31
	4.56	3.31	1.25	6.5	3.5	3.00	4.31	2.43	1.87	3.12	2.25	1.00
	5.56	3.00	2.56	4.75	2.5	2.25	4.25	2.18	2.06	4.37	2.06	2.31
	4.31	2.56	1.75	4.56	2.12	2.43	4.00	2.00	2.00	3.56	1.81	1.75
	3.62	2.18	1.43	4.12	2.12	2.00	2.43	1.43	1.00	3.06	1.62	1.43
	4.68	2.62	2.06	4.31	2.5	1.81	4.12	2.62	1.5	3.87	2.31	1.56
	4.06	2.25	1.81	3.62	1.06	2.56	4.5	2.43	2.06	3.56	2.25	1.31
	2.75	1.62	1.12	2.62	1.62	1.00	2.25	1.25	1.00	2.81	1.56	1.25
	3.37	1.37	2.00	2.56	1.5	1.06	3.00	1.56	1.43	2.5	1.31	1.18
	2.37	1.12	1.25	2.5	1.5	1.00	2.5	1.37	1.12	3.37	1.37	2.00
Totals	63.62	36.68	26.93	63.25	34.00	29.25	49.43	28.12	21.31	48.87	27.81	21.06

In this table the results are given of the two years' tests in a more condensed form, and arranged in relation to the selections from large and small seeds. On the left are given the figures for the large selections and on the right those from the small:

1887.	Pounds.	1887.	Pounds.
Largest Selection of 1887.		Smallest Selection of 1887.	
Total crop	14.89	Total crop	11.96
Weight of straw	5.98	Weight of straw	4.75
Weight of grain	8.90	Weight of grain	7.21
1888.		1888.	
Largest Selection of 1888 from Largest of 1887.		Smallest Selection of 1888 from Largest of 1887.	
Total crop	63.62	Total crop	49.43
Weight of straw	26.93	Weight of straw	21.31
Weight of grain	36.68	Weight of grain	28.12
Largest Selection of 1888 from Smallest of 1887.		Smallest Selection of 1888 from Smallest of 1887.	
Total crop	63.25	Total crop	48.87
Weight of straw	29.25	Weight of straw	21.06
Weight of grain	34.00	Weight of grain	27.81

It was intended to continue these experiments during the season for 1889, and selections of large and small seeds from the crops of 1888 were made and planted, but the season proved so unsatisfactory that practically a failure resulted with the entire crop. This was due to the peculiar climatic conditions which prevailed and fungous diseases which attacked the plants. During the continued wet weather many seeds rotted, and a large percentage of young plants were lost after vegetating from the same cause. During June those plants which survived were attacked by a fungous disease, by which the crop was practically destroyed. It is, however, intended to continue the investigation another season.

Notes on Vegetation of Beans.

A careful count was made of the number of plants in each row from the time vegetation commenced on June third until July second, inclusive. From these notes the most interesting facts are indicated in the experiments made, and if they can be verified by future experiments may become most valuable. We will take for the purpose of illustration the number of vegetations of the large and small seed for four periods, viz.: June third, the first day that seed began to vegetate; June tenth and twentieth, and July second, when the last count was made. From these we make up the following tables:

	LARGE SEED FROM TABLE 1.				SMALL SEED FROM TABLE 3.			
	Date, June 3.	Date, June 10.	Date, June 20.	Date, July 2.	Date, June 3.	Date, June 10.	Date, June 20.	Date, July 2.
	3	102	104	88	4	91	88	69
	2	92	95	86	3	82	77	70
	1	98	96	89	13	78	71	56
	2	90	92	83	32	89	86	73
	2	105	93	86	9	90	78	64
	4	112	99	85	6	91	80	71
	2	112	102	87	0	100	90	73
	5	104	100	78	6	80	85	74
	3	103	96	89	24	83	75	56
	4	93	86	84	18	92	88	82
Totals	28	1011	923	853	115	876	798	688

	LARGE FROM SMALL FROM TABLE 2.				SMALL FROM SMALL, TABLE 6.			
	Date, June 3.	Date, June 10.	Date, June 20.	Date, July 2.	Date, June 3.	Date, June 10.	Date, June 20.	Date, July 2.
	2	105	111	88	9	97	97	66
	0	102	100	76	4	90	86	66
	3	99	89	87	2	67	68	44
	5	101	96	85	18	93	83	68
	6	114	104	91	19	84	80	74
	7	108	105	92	8	95	83	60
	1	111	100	91	3	92	86	72
	0	102	98	83	9	90	71	59
	4	107	97	66	9	89	78	69
	5	92	87	80	16	79	65	62
Totals	33	1041	987	839	97	876	786	640

	FROM LARGE SEED AS IT GREW, TABLE 7.				FROM SMALL SEED AS IT GREW, TABLE 8.			
	Date, June 3.	Date, June 10.	Date, June 20.	Date, July 2.	Date, June 3.	Date, June 10.	Date, June 20.	Date, July 2.
	13	99	98	85	5	101	101	83
	3	98	94	78	2	92	88	66
	2	78	79	69	11	76	78	70
	18	96	100	88	13	82	91	73
	13	99	96	85	10	96	87	77
	4	105	106	89	5	91	85	72
	1	107	95	77	1	93	85	74
	12	102	83	85	3	97	82	61
	15	96	95	80	16	85	86	69
	12	96	90	77	3	90	89	79
Totals	93	976	936	813	69	903	873	724

In the first half of table 1, and in the first column at the left, we find the total number of vegetations on June third, from the large seed, to be twenty-eight. In a corresponding column in the other half of the table, we have the total of the small seed, 115, a difference of eighty-seven plants. In the next column at the right of those just given, we have the vegetations for the next period of seven days of the same seed, which are 1,011 in large and 876 in small, or 135 plants in favor of the large seed. In the last column for the fourth period, we find 853 credited to large and 688 to the small beans, or 165 plants in favor of large seed, showing that the large seed vegetated slower at first, but at the beginning of the second period it had overtaken, and, in every instance, outnumbered those from the smaller seeds. In the second table given, showing the number of seeds vegetating in the same periods, from large beans selected from small seed of the former year and small seed taken from the small beans of the same year, we find the figures in corresponding columns verifying the statements made in reviewing the first table, viz.: In the first period sixty-four plants in favor of small, and in second and third periods, 165 and 199 respectively, the gain of the large when compared with small in periods one and two. But in the third table giving the vegetation of the mixed seeds planted without selection, we have the conditions reversed in the first vegetations, in a diminished degree, however; and in periods two, three and four, the gain of the large over small, is less than in any of the other selections for

TABLE SHOWING GROWTH OF BEANS FOR THREE PERIODS, LARGE AND SMALL SEED.

Date when measurements were taken.	Number of plants measured.	Number of selection.	Total height in inches.	Date when measurements were taken.	Number of plants measured.	Number of selection.	Total height in inches.	Date when measurements were taken.	Number of plants measured.	Number of selection.	Total height in inches.
March 7..........	5	1	8.0	March 14........	5	1	22.5	March 20..........	5	1	41.75
March 7..........	5	2	9.87	March 14........	5	2	17.5	March 20..........	5	2	40.75
March 7..........	5	3	10.0	March 14........	5	3	17.5	March 20..........	5	3	50.5
March 7..........	5	4	11.0	March 14........	5	4	13.25	March 20...... ...	5	4	27.5

the same periods. From a number of trials made in the greenhouse with beans in direct line with those given above, we have tabulated the following data which we found to bear directly on the experiments under consideration. The beans were of two varieties, Boston Dwarf Early and Arostook. Large and small beans were selected, as explained in the former experiments, and the separate sizes weighed before planting.

In the first couplet we will give the results of a test with the seed of Boston Dwarf Early, comparing the large and small seed, marked Nos. 1 and 2.

Ten seeds of the largest beans planted of this variety weighed sixty-nine grammes. Eight of the ten seeds vegetated. Of this number six produced thirty-nine pods. The greatest number of pods borne by one plant was thirteen. The average for the eight plants was 4.62 pods per plant.

Ten small beans of the same variety weighing thirty-five grammes vegetated nine plants, six of which bore a total of twenty-eight pods. The greatest number found on one plant was nine pods, and the average 3.11 pods per plant.

In the second couplet we make a like comparison of the second variety, numbered 3 and 4. Ten large beans selected from the Arostook weighed fifty-six grammes. Seven of these vegetated, and all bore. The total number of pods produced was twenty-eight. Seven pods was the greatest number produced by one plant, and the average per plant was four pods. The weight of ten small seeds of the same variety was twenty-eight grammes. They produced nine plants, eight of which bore a total of twenty-four pods, bearing on an average 2.66 pods per plant.

From measurements taken of the plants at different periods of growth, we have the preceding table, showing not only that the plants grown from the large seed were more productive, but that after the first measurement the plants from the large seed took the lead and maintained it to the end, which would indicate a plant of vigorous constitution, with increased seed-bearing powers, from the large seed.

A study of the preceding experiments does not indicate that definite results have been reached, but we think the following conclusions are probable:

First. That the retarded vegetation of the large seed for the first period is due to the larger amount of dry matter to be acted upon by the moisture in the soil and for the chemical and other changes necessary to cause germination.

Second. That the larger amount of dry matter contained in the large seed after it becomes converted into available food for the young plants furnishes them with greater power to overcome any adverse condition attending vegetation, transmitting to the plant a more vigorous constitution and furnishing a greater resistive power to the diseases attacking the plant.

Third. That the number of seeds germinating or vegetating in the first few days is not a correct measure of the vitality of the seed as has been shown in the two sets of seed of the same variety but of different size.

Fourth. That were it possible to select large and small seed of the same vitality it is probable that the small seed would give a larger number of germinations in the first period of seven days which might be thought to indicate a greater vitality and germinating power for the small seed, whereas in the end the large seed might give the same or a greater number of plants of more vigorous growth.

Fifth. That from these experiments it would seem advisable in testing the germinating power of seeds from different sources to take into consideration the weight of the seed as well as their age.

REPORT OF ACTING METEOROLOGIST.*

NOTES ON FLUCTUATIONS IN HEIGHT OF WATER IN AN UNUSED WELL.

There is a well on the roadside northeast of the Station buildings. For several years it had been unused, when measurement of the distance from the top of the curbstone was begun in December, 1886.†

There has been found an unaccountable rise and fall of the water in this well which has been compared with the rainfall as herewith, with atmospheric pressure, and with speculations, but no tenable explanation of the phenomena has heretofore been found.

The height of the water in the well on the first day of each month, with interpolations for 1889 at various dates on which changes in the direction of variation took place, and also the rainfall for the month preceding, for two years, is here given. In order to make the figures more readily intelligible, the results are also presented in graphic form the same as in the previous report and including all the data there given.

The method of and scale for the graphic diagram is the same as first adopted. The scale is one-third inch between vertical lines for months and one-sixth inch between the horizontal lines reduced about half for printing. "Each mark in the water-table record indicates one foot, measured from the top of the diagram, and, in the record of precipitation, each mark represents one-fifth of an inch, measured from the bottom." A few facts which have been noted, in relation to the changes of level of the water in this well, are:

1. Fluctuations in the precipitation from month to month did not much affect the height of the water-table. The very light precipitation of January, 1887, did not stop the rise of the water-

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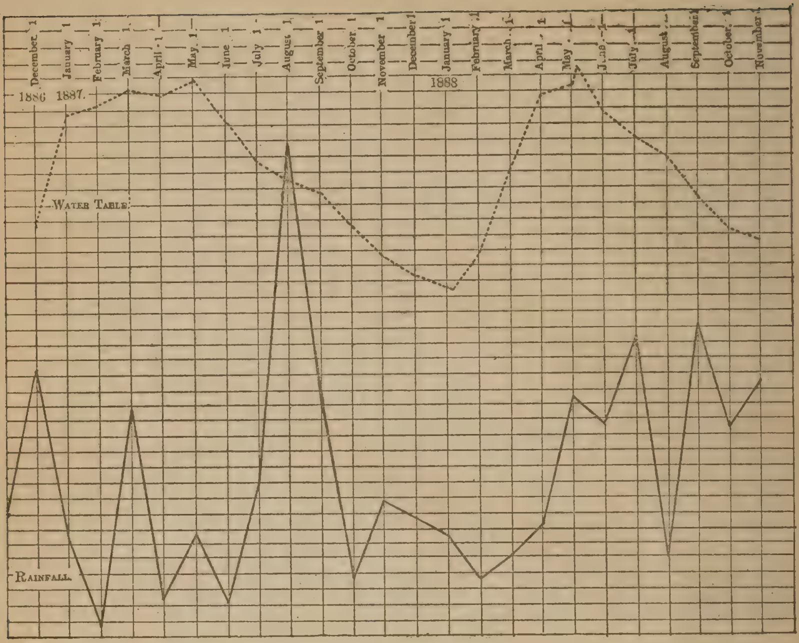
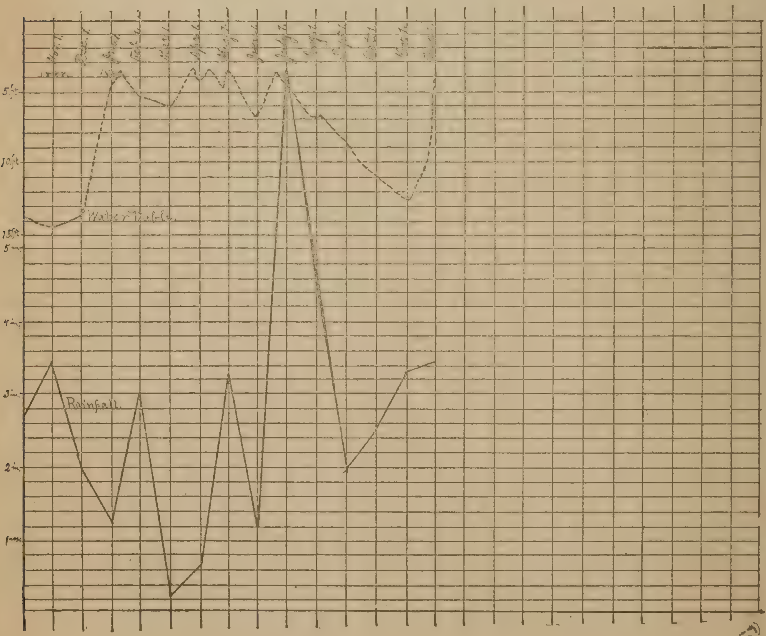
* Frank E. Emery, Acting Meteorologist.

† Station Report 1888, pp. 197-8.


December 1
January 1
February 1
March 1
April 1
May 1
June 1
July 1
August 1
September 1
October 1
November 1
December 1
January 1
February 1
March 1
April 1
May 1
June 1
July 1
August 1
September 1
October 1
November 1
1886
1887.
1888
WATER TABLE
RAINFALL.


5 ft.
10 ft.
15 ft.
5 in.
4 in.
3 in.
2 in.
1 in.
Water Table.
Rainfall.

table, nor did the extremely large rainfall of July of the same year cause the water-table to stop falling.

2. The rapid rise in the water-table from January 7 to April 1, 1888, or from December 1, 1888, to January 1, 1889, was not due to large precipitation during this time, nor was the fall from May 7 to November 1, 1888, due to small precipitation.

3. The rapid rise of water from November 18 to December 1, 1889, was in part at least due to the heavy rainfall of the eighteenth to twenty-third, which found the soil nearly or quite saturated. The rainfall for that time was 2.60 inches, followed by .51 inches more during the later days of November.

4. The curve of the water-table accompanying this indicates an intermittent character which is either natural or artificial.

	1886.			1887.			1888.			1889.		
	Distance to water.		Rainfall of preceding month.	Distance to water.		Rainfall of preceding month.	Distance to water.		Rainfall of preceding month.	Distance to water.		Rainfall of preceding month.
	Feet.	Inches.	Inches.	Feet.	Inches.	Inches.	Feet.	Inches.	Inches.	Feet.	Inches.	Inches.
January 1				6	4.0	1.24	17	3.5	1.34	4	6.75	1.24
January 8										3	7.25	
February 1				5	8.0	.18	15	3.25	.78	5	1.25	2.99+
March 1				4	10.25	2.97	9	11.75	1.04	6	.25	.25
March 27										3	2.75	
April 1				5	.75	.48	5	1.75	1.43	4	3.25	.66+
April 6										3	7.75	
April 27										4	9.25	
May 1				4	2.25	1.37	4	8.0	3.09	3	7.75	3.28
May 31										6	8.75	
June 1				6	10.0	.46	6	2.75	2.79	6	7.50	1.21
June 18										3	9.75	
July 1				9	2.0	2.01	7	10.25	3.88	4	6.25	7.47
July 18										6	5.50	
July 24†										6	8.0	
August 1				10	5.75	6.37	9	2.5	.99	6	11.0	4.56
August 6										6	8.25	1.98
September 1				11	3.0	3.03	11	7.5	4.02	8	7.75	
October 1				13	4.5	.75	13	9.25	2.73	10	10.25	2.50
November 1				15	4.5	1.74	14	4.0	3.46	12	6.0	3.32
November 18										10	5.50	
December 1	13	2	3.48	16	9	1.58	12	8.0	1.58	4	7.0	3.44

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† At this date the measurements were made direct from the top of the curbstone, which averages 12.6 inches above the surface.

In order to discover whether it were possible that some old forgotten syphon is discharging the water in this well, a trench was dug around it to a point six inches lower than the water level at the time. This trench penetrated into soil which appeared never to have been before disturbed and nothing which could conduct away the water was found.

METEOROLOGY OF 1889.

The past season will be remembered as a wet one. It has been one in which monthly extremes of temperature and rainfall have alternated. January was a remarkably warm month, and there was a heavy rainfall for a winter month. February was nearly as much colder than the average as January was warmer, and gave a correspondingly small amount of precipitation. These ranges of temperature have been moderate, but those of rainfall have been wide, while the total fall of rain has been much in excess for this locality.

The heavy rainfall during the warmest part of summer gave parasitic fungi such an opportunity for development that almost every host was severely taxed. Some of the most noticeable of these attacks were the smut on corn (*Ustilago madis, corda*) which loaded the tassels and took the place of ears in many cases. Clover leaves withered and died down soon after being developed from the attacks of the clover parasites. Chief among these here was *Uromyces trifolii.* Another fungus ruined the oat crop, and others attacked the potato, apple, pear, small fruits and so on to the flower garden, where a hollyhock fungus developed which is known to have spread over Europe from South America and ruined the host wherever it spread.

The monthly extremes of temperature with the range is given in the following table, together with the monthly means of the four previous years. A column is given which shows the monthly mean for five years.

It is to be regretted that these records have been broken into by some criminally disposed person. Twice during this season we have been obliged to purchase new instruments to replace others wantonly destroyed at night by parties passing on the highway.

EXTREMES AND RANGE OF TEMPERATURE FOR 1889, WITH MONTHLY MEANS FOR FOUR YEARS.

	Maximum.	Minimum.	Mean of maximum.	Mean of minimum.	Greatest range.	Mean monthly temperature.	Mean monthly temperature.	Mean monthly temperature.	Mean monthly temperature.	Mean monthly temperature.	Monthly temperature, mean of five years.
1889.						1889.	1888.	1887.	1886.	1885.	
January	55.0	5.0	36.0	22.2	50.0	29.10	17.86	21.60	20.58	21.05	22.04
February	42.0	—7.0	26.8	9.2	49.0	19.83	24.38	25.42	23.22	14.23	21.42
March	61.8	18.5	40.5	26.7	43.3	35.27	25.98	27.65	32.37	21.15	28.48
April	84.0	26.0	54.8	35.3	58.0	46.90	43.28	43.85	50.40	43.78	45.64
May	91.8	32.0	68.7	48.8	59.8	57.82	56.40	65.80	58.45	58.03	59.30
June *	85.0	46.0	74.6	54.6	39.0	65.50	70.45	69.22	67.95	66.93	68.01
July	90.7	53.0	79.1	59.6	37.7	72.40	71.16	78.00	71.47	72.91	71.19
August	86.7	50.5	75.9	55.6	36.2	68.33	70.48	68.92	69.70	65.98	68.68
September †	84.0	40.0	68.9	50.2	44,0	61.30	59.84	59.55	63.60	60.65	60.99
October	68.7	21.2	51.6	36.5	47.5	43.73	44.37	46.11	51.07	49.04	46.86
November	61.7	17.8	46.3	33.8	43.9	40.18	39.28	37.30	37.17	39.90	40.77
December	......	......	......	......	......	......	29.73	28.35	22.85	28.89	‡27.46
Mean yearly temperature	......	......	......	......	......	......	46.10	47.65	47.40	45.21	‡46.59

* The thermometers were wantonly destroyed on the night of June first. The maximum record is for twenty-four days, and the minimum for twenty-seven days. † The thermometers were wantonly destroyed on the night of September fourth. The maximum record is for twenty-three days, and the minimum for twenty-seven days. ‡ Mean of four years.

During only three months has the monthly range of temperature been greater than in 1888, while during eight months the range was from 3.1° to 21.1° F. less than in that year. The average was 9.9° F. less for the eight and 7.9° F. more for the three months. This depression of range harmonizes with the rainfall, and shows that with the greater amount of water in the soil and atmosphere there is a more equable temperature.

By adding the mean monthly temperature for the corresponding months of each year, we find the column of monthly mean temperature for five years, including eleven months of 1889. Comparing each of these eleven months with this monthly mean we find six below the mean and five above. Combining the differences gives 7° F. above the mean temperature for the eleven months of 1889.

The greatest depression of the mean monthly of any month below the general mean for that month was October, 3.1°, and June, 2.5° F.

The greatest corresponding elevation above the mean was January, 7.1°, and March, 6.8° F.

The number of days in each month on which there was an appreciable amount of precipitation is recorded and compared with similar data for previous years. The average number of days on which precipitation was appreciable has been, in seven and one-half years, 125 per year.

Days on which Precipitation was Appreciable.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1882..........	...	....	....	....	....	9	12	10	6	7	7	4	55
1883..........	13	13	12	11	16	12	13	9	10	10	5	11	135
1884..........	11	14	16	11	15	10	12	6	7	13	8	10	137
1885..........	12	7	8	13	13	12	9	20	6	12	15	12	139
1886..........	12	11	11	10	7	7	12	6	11	9	11	13	120
1887..........	12	15	10	9	7	9	10	7	5	15	9	9	117
1888..........	14	6	9	9	16	13	7	11	9	19	12	6	131
1889.........	7	10	5	9	9	15	9	10	7	13	12	12	118
Average of previous years ...	12.3	11.	11.	10.5	12.3	10.3	10.7	9.9	7.7	12.1	9.6	9.7	119.1
1889 + or −.	−5	−1	−6	−2	−3	+5	−2	0	−1	+1	+2	+2	−1

PRECIPITATION BY MONTHS SINCE 1882.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1882	....	....	....	....	....	3.69	2.42	2.37	1.25	0.62	1.22	0.55	.....
1883	0.48	1.44	0.88	1.58	4.45	4.12	2.98	3.47	2.12	2.10	1.54	0.73	25.89
1884	1.83	2.01	2.54	0.83	2.49	2.01	2.33	1.44	3.17	1.67	1.01	0.97	22.30
1885	1.07	0.61	0.12	1.26	1.58	2.49	4.64	5.02	2.11	2.88	1.36	0.76	23.90
1886	1.13	0.95	1.13	4.13	1.92	2.92	4.41	2.86	2.31	1.39	3.48	1.24	27.87
1887	0.18	2.97	0.48	1.37	0.46	2.01	6.37	3.03	0.75	1.74	1.58	1.35	22.29
1888	0.78	1.04	1.43	3.09	2.79	3.88	0.99+	4.02	2.73	3.47	2.02	1.24+	27.48
1889	2.99+	0.25	0.66+	3.28	1.21	7.47	4.56	1.98	2.50	3.32	3.44	1.62	32.28

From the above table we deduce the mean monthly rainfall since and including June, 1882. Below is a comparison of this mean monthly rainfall with the rainfall of 1889:

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Mean monthly rainfall ...	1.21	1.324	1.034	2.22	2.13	3.574	3.588	3.024	2.118	2.15	1.956	.977
Rainfall, 1889..............	2.99+	0.25	0.66	3.28	1.21	7.47	4.56	1.98	2.50	3.32	3.44	1.62
For 1889 + or — mean	1.78+	—1.074	—0.374	+1.06	—0.92	+3.896	+0.972	—1.044	+0.382	+1.17	+1.484	+ .643

Excess over mean for the year, 7.975 inches.

This record of rainfall for the winter months is hardly to be relied on, since much of the precipitation is snow, which frequently blows over and out of the gauge, so there may often be a considerable fall with not enough lodged in the gauge to be appreciable when melted and measured.

This objection, however, does not affect the summer months, which most concern our farm crops and animals.

During these months, from April to October inclusive, the rainfall for 1889 has exceeded the average for the corresponding months of the six and one-half years in five cases, and was less in only two, May and August. The excess for these months was 5.516 inches more than the average for the corresponding months.

FROSTS.

The latest frosts in spring and earliest in fall were May twenty-eighth, twenty-ninth, and September fourteenth, making the season between 108 days, the same as for 1888. But corn planted May sixth was not killed by the frost of twenty-eighth, twenty-ninth, though potatoes and beans were killed.

The frosts of September fourteenth was followed by others on the fifteenth, sixteenth, eighteenth, nineteenth and twenty-first, and the ground was slightly frozen on the twenty-third of the same month.

SOME CASUAL PHENOMENA OBSERVED DURING THE SEASON HAVE BEEN AS FOLLOW:

	Frosts.	Polar bands.	Auroras.	Solar halos.	Lunar halos.	Rainbows.	Mock suns.
January	13	....	....	......	......	.. ..	12
February	4	....	....	......	......	....	....
March	5, 6, 16, 17, 18, 22, 23, 24, 26	....	....	......	......	....	....
April	5, 7, 14 15, 16	....	... .	......	......	....	....
May	29	....	....	......	......	....	....
June	....	....	....	......	......	4, 21, 22	....
July	....	....	....	17	......	....	....
August	....	....	....	......	......	12	....
September	14, 15, 16, 18, 19, 21	21	....	......	......	....	....
October	....	....	....	......	......	....	....
November	4, 7,	....	....	26	......	....	....

WIND RECORD.

The record of direction of the wind has been kept through the year and is given below. The record of distance of movement has not been satisfactory until very recently. Changes in the apparatus designed to give this record have made it possible to get the miles of movement in a given time. This apparatus is on the principle of the Robinson anemometer. The recording part depends on the vertical movement of a pencil on paper drawn laterally by clock-work, one inch per hour. The pencil should move about three-sixteenths of one inch for every ten thousand revolutions of the apparatus and each revolution is calculated to denote the passage of very nearly twenty-one feet of air.

Following is the record of direction in detail for one year:

Combining the summaries for each month for the nine months recorded in 1888* shows the prevailing winds to have been from a westerly direction.

The same summary for the first ten months of 1889 shows the prevailing winds to have been from the same (westerly) direction, as shown in the table below.

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* See Seventh Ann. Rep., pp. 174–5, for seven months' record.

WIND RECORD NOVEMBER, 1888, TO FEBRUARY, 1889.

DATE.	NOVEMBER.				DECEMBER.				JANUARY.				FEBRUARY.			
	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S. E,	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	....	....	17.0	1.0	....	....	....	24.0	....	....	3.0	20.0	....	....	5.0	19.0
2	....	....	24.0	....	....	....	....	24.0	....	....	....	20.0	....	....	14.5	5.0
3	....	....	17.0	7.0	....	....	....	....	....	....	3.0	7.0	4.0	....	8.75	11.25
4	....	2.5	11.5	8.0	....	....	10.0	10.0	....	....	4.0	....	3.0	....	12.0	....
5	....	24.0	....	....	....	....	10.0	14.0	4.0	....	....	....	....	....	24.0	....
6	....	....	....	....	9.5	....	....	7.5	17.0	....	....	....	....	....	3.5	20.5
7	....	....	4.0	14.0	....	....	12.0	12.0	2.0	....	....	13.0	....	....	....	24.0
8	1.0	4.0	6.0	....	....	....	2.0	22.0	....	....	....	19.0	....	....	12.0	10.5
9	....	....	7.0	15.0	....	....	2.0	1.0	....	11.0	11.5	....	....	....	20.0	....
10	2.5	4.0	1.25	6.5	....	....	....	....	....	....	....	....	....	....	24.0	....
11	....	....	....	24.0	....	....	24.0	....	....	....	....	....	....	12.0	8.0	....
12	4.0	....	....	20.0	....	....	....	24.0	....	....	8.0	12.0	....	....	7.0	17.0
13	3.0	2.5	8.0	....	8.0	....	....	16.0	....	....	5.5	4.0	....	....	....	24.0
14	....	....	20.0	1.0	4.0	....	....	20.0	....	....	....	....	....	....	....	24.0
15	....	....	....	....	....	....	7.0	14.5	....	1.0	2.5	1.25	1.5	....	....	17.0
16	3.0	1.5	2.5	9.5	....	....	....	....	....	....	18.0	....	.5	2.0	8.5	....
17	2.0	....	3.0	19.0	....	....	24.0	....	....	18.0	3.5	2.5	....	....	5.+	....
18	2.0	4.0	....	7.0	16.0	....	....	....	....	....	8.5	15.5	10.0	....	....	13.0
19	....	23.0	1.0	....	13.0	....	....	11.0	4.0	....	....	20.0	1.0	2.5	20.5	....
20	16.5	....	2.0	5.5	....	....	....	....	11.5	5.0	7.0	....	....	....	....	24.0
21	6.5	2.0	....	....	....	....	....	....	....	....	24.0	....	....	....	8.0	16.0
22	3.0	2.0	1.0	....	....	....	....	....	....	....	....	24.0	....	....	22.0	2.0
23	10.0	3.5	....	....	....	....	....	....	....	....	16.5	2.0	7.0	....	....	17.0
24	....	20.0	4.0	....	....	....	....	....	....	....	24.0	....	....	....	6.0	18.0
25	15.0	3.0	....	....	....	....	....	....	....	....	7.0	2.0	6.0	....	9.5	8.5
26	24.0	....	....	....	....	....	....	....	....	....	13.0	....	2.0	....	12.0	2.0
27	18.0	....	....	6.0	....	....	....	....	....	6.0	....	....	....	....	24.0	....
28	....	....	....	24.0	....	....	....	....	7.0	....	....	10.0	5.5	....	4.0	1.5
29	....	....	....	24.0	....	....	....	....	....	....	12.0	12.0	....	....	....	....
30	....	....	....	24.0	....	....	....	....	....	....	7.0	15.5	....	....	....	....
31	....	....	....	....	....	....	....	....	....	17.5	5.0	....	....	....	....	....
Total hours of movement	110.5	96.0	129.25	215.5	50.5	00.0	91.0	200.0	45.5	58.5	183.0	199.75	40.5	16.5	255.25	274.25
Per cent of time in each direction	20.0	17.4	23.5	**39.1**	14.8	00.0	26.6	**58.6**	9.3	12.0	37.6	**41.0**	6.7	2.8	43.5	**46.8**

WIND RECORD MARCH TO JUNE, 1889.

DATE.	MARCH.				APRIL.				MAY.				JUNE.			
	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	......	.	10.5	1.0	13.0	2.5	2.0	......	....	....	......	24.0	1.5	14.0	2.0	5.5
2	......	....	22.0	......	.5	....	....	......	3.0	....	......	20.0	4.5	5.25	2.0	2.0
3	......	....	6.0	......	.+	5.0	3.5	2.0	2.0	....	......	22.0	....	6.5	11.0	1.0
4	3.0	....	.5	......	7.0	....	....	16.0	....	...	......	16.5	1.0	4.0	6.0	.5
5	......	....	......	11.0	....	3.0	.5	7.0	....	....	......	24.0	4.0	....	1.0	6.0
6	6.0	....	......	18.0	1.5	9.5	....	......	....	....	......	12.0	....	....	......	24.0
7	9.0	....	......	15.0	....	2.5	....	......	21.0	....	......	3.0	....	5.0	3.0	16.0
8	......	....	......	24.0	....	...	....	......	2.5	....	......	20.5	....	....	24.0	......
9	6.0	....	......	18.0	....	....	....	......	....	4.0	3.0	5.0	....	5.0	7.0	......
10	14.0	....	......	10.0	....	....	...	......	....	....	4.0	19.0	2.0	1.0	4.0	4.0
11	14.0	....	......	10.0	....	....	....	......	5.0	....	......	18.0	1.5	....	1.5	11.0
12	......	....	5.0	15.0	....	....	....	......	6.0	....	......	5.0	....	....	3.5	9.5
13	......	....	......	13.0	22.0	....	....	2.0	....	3.5	2.0	6.0	....	....	11.0	7.5
14	9.0	4.0	......	11.0	3.0	....	....	18.0	...	1.0	......	3.5	.5	4.0	......	11.0
15	......	8.0	10.5	......	7.0	4.5	....	2.5	3.5	....	......	17.0	....	6.0	5.0	1.5
16	......	2.0	6.0	......	4.0	7.0	2.0	2.0	2.0	3.0	3.0	6.0	....	2.0	2.0	7.0
17	9.0	3.0	......	......	3.5	10.0	3.25	......	5.0	2.0	7.0	1.0	2.0	....	2.5	......
18	11.0	....	......	......	1.5	3.0	4.0	......	....	7.0	8.5	3.0	6.5	3.5	......	......
19	7.0	1.5	1.0	......	....	6.0	9.0	......	....	....	20.0	......	....	12.0	12.0	......
20	24.0	....	...	......	1.0	2.5	8.0	5.0	....	....	9.0	2.5	....	4.0	7.0	12.0
21	24.0	....	......	......	4.0	....	7.0	10.0	2.0	4.5	.5	4.0	....	4.0	5.0	5.5
22	12.0	....	......	2.5	....	....	....	24.0	....	....	......	22.0	....	1.0	2.5	20.0
23	5.5	....	......	6.0	....	....	....	24.0	....	....	......	24.0	....	....	......	22.0
24	......	....	......	......	....	12.5	11.5	......	....	....	2.0	11.0	....	....	2.0	8.5
25	14.0	2.0	......	7.0	....	8.5	11.0	3.0	6.5	1.0	......	13 5	....	1.0	1.0	......
26	8.0	....	3.5	2.5	....	1.5	....	16.5	5.5	...	......	4.5	....	6.0	7.0	......
27	......	4.0	12.5	.....	4.0	....	....	20.0	.5	14.0	1.0	......	....	2.5	2.5	6.0
28	......	....	2.0	16.5	4.5	....	....	19.5	....	3.0	11.5	9.5	....	4.0	4.0	......
29	1.0	....	2.5	17.0	....	....	2.0	22.0	....	3.5	......	19.0	4.0	....	2.5	.+
30	......	....	......	24.0	....	....	....	24.0	.5	8.5	8.5	......	4.0	1.0	......	......
31	......	....	......	......	....	....	...	......	....	24.0	......	......	....	....	......	......
Total hours of movement	176.5	24.5	82.0	215.5	76.5	78.0	63.75	217.5	46.0	79.0	80.0	335.5	31.5	91.75	131.0	180.5
Per cent of time in each direction	35.4	4.8	16.4	**43.2**	17.6	17.9	14.6	**49.9**	8.5	14.6	14.8	**62.1**	7.2	21.1	30.1	**41.5**

WIND RECORD, JULY TO OCTOBER, 1889.

DATE.	JULY.				AUGUST.				SEPTEMBER.				OCTOBER.			
	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.	Northerly, N.W. to N.E.	Easterly, N.E. to S.E.	Southerly, S.E. to S.W.	Westerly, S.W. to N.W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	....	17.0	....	....	....	....	.5	....	6.0	3.0	1.0	.75	....	1.0	22.0	1.0
2	....	22.0	2.0	....	....	....	9.0	3 0	....	11.0	6.5	....	....	....	1.0	23.0
3	....	6.0	15.0	....	....	....	9.0	10.5	....	1.0	11.0	....	....	1.0	5.5	6.5
4	....	3.0	11.5	9.5	....	....	....	24.0	....	6.0	8.0	....	....	....	3.25	13.0
5	1.0	....	....	16.0	1 0	....	....	11.0	....	2.0	21.0	....	....	....	4.5	11.0
6	9.5	1.0	....	....	....	....	....	16.0	....	2.0	14.0	8.0	....	1.5	14.5	8.0
7	....	3.0	.5	4.0	3.0	....	....	11.0	....	2.0	....	1.0	....	....	....	24.0
8	....	....	....	14.0	2.0	3.0	2.0	3.5	....	....	....	....	....	....	....	24.0
9	....	....	....	16.25	....	4.0	12.0	2.0	....	....	....	....	....	....	....	24.0
10	.25	....	....	17.0	....	....	3.0	12.0	4.0	3.0	....	....	....	....	6.0	16.0
11	1.5	....	1.0	10.0	....	....	....	22.0	2.5	6.0	....	....	....	....	8.0	7.25
12	....	....	....	8.5	....	....	....	17.5	4.0	4.0	....	....	1.0	.25	3.0	....
13	2.5	....	3.5	3.0	....	....	1.5	11.0	....	15.0	....	....	21.5	....	....	....
14	....	....	....	18.5	....	7.5	8.0	....	....	21.0	1.0	....	12.5	....	....	....
15	10.0	....	....	4.0	....	....	5.0	19.0	....	8.0	9.0	....	9.5	....	....	9.0
16	4.0	....	....	18.5	....	....	3.0	13.0	....	....	13.5	2.0	3.0	....	....	2.5
17	....	....	....	24.0	....	....	....	17.0	.5	....	....	5.0	2.0	....	4.5	3.5
18	4.5	7.0	....	....	....	....	....	11.0	....	5.0	....	13.0	....	....	....	21.0
19	....	6.0	16.0	....	....	1.5	5.0	4.0	....	....	1.5	13.0	....	....	5.0	6.0
20	....	5.0	3.0	16.0	....	....	....	9.5	....	....	12 0	11.0	....	....	13.5	7.0
21	2.0	....	....	19.0	....	....	5.5	1.0	....	....	7.0	17.0	2.0	....	....	5.5
22	5.5	3.5	....	....	....	....	3.0	15.0	....	....	....	24.0	3.5	....	....	3.5
23	3.5	2.0	....	9.0	....	1.5	2.0	5.5	....	....	....	8.0	7.5	....	....	3.0
24	2.0	....	....	22.0	....	3.5	....	3.5	....	8.0	2.0	.25	3.75	....	....	5.0
25	....	....	....	18.0	5.0	2.0	....	.5	....	3.5	12.0	....	....	10.0	7.25	....
26	1.0	5.0	....	3.0	3.5	5.0	....	1.0	....	3.0	13.0	6.75	....	7.0	6.0	....
27	....	15.0	9.0	....	....	17.0	....	....	....	....	....	20.0	....	5.0	1.0	....
28	....	9.0	15.0	....	....	6.0	2.0	....	....	....	....	24.0	14.5	....	....	9.0
29	....	5.0	17.0	....	....	5.0	1.0	....	....	1.5	....	15.5	6.0	....	....	18.0
30	....	....	3.0	4.5	....	3.5	18.0	1.0	....	4.0	10.0	....	7.5	....	....	....
31	....	3.0	3.0	....	4.5	....	....	4.5	....	....	....	....	1.5	11.25	6.0	....
Total hours of movement	47.25	113.0	99.5	254.75	19.0	43.5	89.5	249.0	17.0	109.0	142.5	169.25	95.75	37.0	111.0	250.75
Per cent of time in each direction	9.2	22.0	19.3	**41.0**	4.7	10.8	22.1	**62.1**	3.9	24.9	32.6	**38.7**	19.3	7.5	22.4	**50.7**

SUMMARIES OF DIRECTION OF WIND FOR 1888 AND 1889.

	Northerly, north-west to north-east.	Easterly, north-east to south-east.	Southerly, south-east to south-west.	Westerly, south-west to north-west.
1888.	Hours.	Hours.	Hours.	Hours.
January	....	....	....	....
February	....	....	....	....
March	....	....	....	....
April	96	12	42	150
May	65	13	181	131
June	51	29	44	112
July	27	15	52	51
August	83	20	52	196
September	71	41	132	196
October	69	42	84	202
November	110.5	96	129.25	215.5
December	50.5	00	91.00	200.0
Total hours for nine months	623	268	767.25	1453.5
Per cent of time from each direction	20.0	8.6	24.7	**46.7**
1889.				
January	45.5	58.5	183.	199.75
February	40.5	16.5	255.25	274.25
March	176.5	24.5	82	215.5
April	76.5	78	63.75	217.5
May	46.0	79.0	80.0	335.5
June	31.5	91.75	131.0	180.5
July	47.25	113.0	99.5	254.75
August	19	43.5	89.5	249
September	17.0	109	142.5	169.25
October	95.75	37.0	111 0	250.75
November	....	....	....	....
December	....	....	....	....
Total hours for ten months	595.5	650.75	1237.5	2346.75
Per cent of time from each direction	12.3	13.5	25.6	**48.6**

RECORDS OF SUNSHINE.

These records were begun in May, 1885, and in the report for that year a description of the instruments was given and the hope was expressed that "the continuation of these records for several years, together with careful observations upon the growth of plants, may show some relation between the amount of sunshine and plant development."

The records were kept continuously until the end of August, 1887, when a failure to procure properly prepared paper, caused its being dropped for a time. It was resumed for four months of 1888, June to September inclusive. The full record for 1889 has been made and is given below.

The method first adopted of giving the daily records under four headings before 9 A. M., from 9 to 12 M., 12 M. to 3 P. M., and all after 3 P. M. has been followed.

This record is followed by a condensed summary by months of the records previously made.

The summary shows more sunshine in the first four months of 1889 than in the corresponding months of 1886–7, but for May, June and September there was a much less than average amount of sunshine. A deficiency of sunlight during these important months, may be fraught with dire consequences to our agricultural plants. This lack of sunshine for June is associated with excessive rainfall. Early fruit could not develop the finest flavors, and late-ripening crops were delayed by this lack of sunshine.

SUNSHINE RECORD FOR 1889 BY NEGRETTI AND ZAMBRA INSTRUMENTS.

DATE.	JANUARY.						FEBRUARY.					
	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.
	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.
1	0.35	3.00	3.00	0.10	6.45	9.08	0.00	0.30	2.15	0.15	3.00	10.00
2	0.00	0.00	0.00	0.00	0.00	9.09	0.00	0.45	0.40	0.00	1.25	10.02
3	1.30	3.00	3.00	0.30	8.00	9.10	0.00	0.00	0.00	0.30	0.30	10.04
4	0.00	2.00	1.00	0.00	3.00	9.11	0.00	0.00	0.00	0.00	0.00	10.07
5	0.00	0.00	0.00	0.00	0.00	9.12	0.00	0.00	0.00	0.00	0.00	10.09
6	0.00	0.00	0.00	0.00	0.00	9.14	1.45	2.00	0.45	0.00	4.30	10.12
7	0.00	0.00	0.00	0.00	0.00	9.15	0.00	0.00	0.00	0.00	0.00	10.14
8	0.00	0.00	0.10	0.00	0.10	9.16	0.00	0.0 +	0.15	0.00	0.15+	10.17
9	0.00	0.00	0.0 +	0.00	0.0 +	9.17	0.00	0.00	0.00	0.00	0.00	10.19
10	0.00	0.00	0.00	0.00	0.00	9.18	0.00	0.00	0.00	0.00	0.00	10.21
11	0.00	0.00	0.00	0.00	0.00	9.19	2.00	3.00	3.00	1.00	9.00	10.24
12	0.00	1.15	3.00	0.30	4.45	9.22	1.50	3.00	3.00	0.00	7.50	10.27
13	1.00	0.45	0.00	0.00	1.45	9.23	1.00	0.10	0.40	0.45	2.35	10.29
14	0.00	0.00	0.00	0.00	0.00	9.24	0.20	1.20	2.40	1.30	5.50	10.31
15	1.15	3.00	2.45	0.00	7.00	9.26	1.45	0.45	3.00	1.45	7.15	10.35
16	0.00	0.00	0.00	0.0 +	0.0 +	9.27	0.00	0.00	0.00	0.00	0.00	10.37
17	1.10	3.00	3.00	0.30	7.40	9.29	0.00	0.00	0.00	0.00	0.00	10.41
18	0.00	0.30	0.0 +	0.00	0.30+	9.30	0.00	0.00	0.00	0.00	0.00	10.43
19	0.0 +	0.00	0.00	0.00	0.0 +	9.33	0.00	2.15	3.00	1.15	6.30	10.46
20	......	......	.....	......	?	9.35	0.30	3.00	1.45	1.15	6.30	10.49
21	......	......	......	......	?	9.36	1.15	2.30	2.30	0.15	6.30	10.52
22	2.00	0.15	0.00	0.20	2.35	9.38	0.00	1.00	0.00	0.00	1.00	10.55
23	1.20	1.30	2.15	0.30	5.35	9.41	2.00	0.15	0.00	0.00	2.15	10.58
24	0.00	0.00	0.20	0.00	0.20	9.42	2.00	3.00	3.00	0.15	8.15	11.01
25	1.45	3.00	3.00	1.15	9.00	9.44	1.45	3.00	3.00	2.30	10.15	11.04
26	0.00	0.00	1.30	1.00	2.30	9.46	0.30	0.40	0.00	0.00	1.10	11.06
27	0.00	0.00	0.00	0.00	0.00	9.49	0.00	0.00	0.00	0.00	0.00	11.10
28	0.00	0.00	0.00	0.00	0.00	9.51	0.00	0.00	0.00	0.00	0.00	11.12
29	0.00	1.30	3.00	1.15	5.45	9.53	......	......	......	......	......	....
30	0.00	0.0 +	0.30	0.00	0.30+	9.56	.....	......	......	......	......	....
31	0.00	0.00	0.00	0.00	0.00	9.58	......	......	......	......	......	....
Total hours	10.35	22.45	26.30	6.00	65.50	294.12	16.40	27.10	29.30	11.15	84.35	296.05
Per cent of possible	19.6	24.3	28.5	11.1	22.4	.....	26.00	32.3	35.1	17.6	28.6	....

SUNSHINE RECORD — (*Continued*).

	MARCH.						APRIL.					
	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.
1	0.30	3.00	2.30	0.00	6.00	11.15	0.00	0.00	0.00	0.00	0.00	12.42
2	0.00	0.00	0.00	0.00	0.00	11.17	0.00	0.00	0.00	0.00	0.00	12.46
3	0.00	0.00	0.00	0.00	0.00	11.20	0.00	0.00	0.00	0.00	0.00	12.48
4	0.00	0.00	0.00	0.00	0.00	11.23	0.00	0.00	0.30	1.30	2.00	12.51
5	0.00	0.00	0.15	0.00	0.15	11.25	3.15	3.00	3.00	1.30	10.45	12.54
6	2.20	3.00	3.00	2.10	10.30	11.28	2.00	2.40	1.45	2.30	8.55	12.56
7	0.15	0.15	0.00	0.00	0.30	11.31	2.45	3.00	3.00	3.00	11.45	12.59
8	0.00	0.00	0.00	0.00	0.00	11.33	3.00	3.00	3.00	2.30	11.30	13.02
9	0.00	0.00	0.00	0.00	0.00	11.36	0.20	2.50	2.45	2.00	7.55	13.04
10	0.00	0.00	0.0 +	0.00	0.00+	11.39	2.45	3.00	3.00	2.00	10.45	13.08
11	2.30	3.00	3.00	1.00	9.30	11.42	1.40	1.30	0.20	0.00	3.30	13.11
12	0.00	0.00	0.00	0.30	0.30	11.45	0.00	0.00	0.00	0.00	0.00	13.13
13	2.00	2.00	1.45	0.45	6.30	11.48	0.00	0.00	0.30	2.30	3.00	13.16
14	1.30	2.30	3.00	2.30	9.30	11.51	2.45	3.00	3.00	2.30	11.15	13.19
15	1.30	3.00	2.15	1.45	8.30	11.53	3.00	3.00	3.00	3.00	12.00	13.21
16	1.30	0.30	3.00	2.45	7.45	11.56	3.00	3.00	3.00	3.00	12.00	13.24
17	0.50	2.50	0.40	0.00	4.20	12.00	3.00	3.00	3.00	3.00	12.00	13.27
18	1.40	0.40	1.00	0.30	3.50	12.03	0.00	0.20	1.00	2.20	3.40	13.30
19	0.00	0.30	3.00	0.40	4.10	12.05	3.00	3.00	3.00	0.30	9.30	13.33
20	0.00	0.00	0.00	0.00	0.00	12.08	0.00	0.00	1.30	2.30	4.00	13.35
21	0.00	0.00	0.15	1.00	1.15	12.11	3.00	3.00	2.00	2.15	10.15	13.38
22	2.30	3.00	1.45	0.00	7.15	12.14	2.00	1.30	3.00	2.45	9.15	13.40
23	2.00	3.00	3.00	2.45	10.45	12.16	1.00	2.30	3.00	1.45	8.15	13.43
24	2.00	1.15	1.30	0.00	4.45	12.19	0.45	0.15	0.15	0.00	1.15	13.45
25	3.00	3.00	3.00	3.00	12.00	12.22	0.00	0.00	0.00	0.00	0.00	13.48
26	2.30	2.00	2.45	1.30	8.45	12.25	0.00	0.00	0.00	0.00	0.00	13.50
27	0.00	0.00	0.00	0.00	0.00	12.27	0.00	0.30	0.00	0.00	0.30	13.54
28	0.00	0.00	0.00	0.00	0.00	12.30	0.00	0.00	0.00	0.00	0.00	13.56
29	2.00	0.30	0.00	0.00	2.30	12.33	0.00	0.30	0.15	0.0 +	0.45+	13.59
30	1.00	0.20	1.30	2.30	5.20	12.36	0.00	0.00	0.00	0.00	0.00	14.01
31	0.00	0.00	0.00	0.00	0.00	12.39	......	......	......	......	......	....
Total hours	30.05	34.20	37.10	22.50	124.25	370.10	37.15	42.35	43.50	41.05	164.45	401.13
Per cent of possible	32.7	36.9	40.0	24.8	33.6	......	33.7	47.3	48.7	37.1	41.0	......

SUNSHINE RECORD — (*Continued*).

DATE.	May.						June.					
	Before 9 A. M.	9 to 12.	12 to 3 P. M.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.	Before 9 A. M.	9 to 12.	12 to 3 P. M.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.
	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.
1	2.30	1.00	0.0 +	0.00	3.30	14. 6	0.00	0.40	0.35	0.00	1.15	15. 5
2	0.00	0.00	0.00	0.00	0.00	14. 8	1.45	1.25	0.20	0.05	3.35	15. 6
3	0.10	2.30	3.00	2.30	8.10	14.11	1.00	0.30	0.00	1.00	2.30	15. 8
4	0.00	2.00	1.30	1.00	4.30	14.13	0.10	2.00	0.50	0.05	3.05	15. 9
5	3.10	3.00	3.00	2.30	11.40	14.15	1.40	1.00	1.15	2.20	6.15	15. 9
6	1.30	2.15	2.30	2.15	8.30	14.12	0.50	2.15	3.00	3.25	9.30	15.10
7	2.45	3.00	3.00	3.00	11.45	14.20	3.00	0.30	0.00	0.00	3.30	15.11
8	3.00	3.00	3.00	3.15	12.15	14.22	0.00	0.00	0.00	0.00	0.00	15.12
9	3.00	3.00	3.00	2.45	11.45	14.25	0.00	2.15	2.00	0.30	4.45	15.13
10	0.00	1.20	0.30	2.00	3.50	14.27	0.15	0.25	2.45	2.00	5.25	15.14
11	1.00	1.40	3.00	3.30	9.10	14.29	0.00	0.00	0.00	0.00	0.00	15.15
12	3.15	2.30	2.45	3.00	11.30	14.31	1.00	0.10	0.15	2.15	3.40	15.15
13	1.30	0.30	0.00	0.00	2.00	14.33	2.50	3.00	2.40	2.00	10.30	15.16
14	0.00	0.00	1.40	1.45	3.25	14.35	2.30	3.00	2.00	2.30	10.00	15.16
15	1.30	3.00	3.00	0.40	8.10	14.37	0.15	0.20	0.45	0.00	1.20	15.16
16	1.30	3.00	1.30	1.15	7.15	14.39	0.45	2.30	1.00	0.45	5.00	15.17
17	3.20	3.00	3.00	3.10	12.30	14.41	0.00	0.00	1.00	1.50	2.50	15.17
18	3.30	3.00	3.00	3.15	12.45	14.43	2.45	3.00	1.15	0.30	7.30	15.18
19	0.00	0.00	0.00	0.30	00.30	14.45	0.00	0.15	1.15	0.30	2.00	15.17
20	0.00	0.00	0.00	0.00	00.00	14.47	2.40	3.00	3.00	2.45	11.25	15.17
21	0.30	0.20	0.00	0.00	00.50	14.49	2.45	2.45	0.30	1.10	7.10	15.17
22	1.30	0.00	0.20	1.40	3.30	14.51	1.45	0.45	2.15	1.20	6.05	15.17
23	0.30	2.50	2.00	2.10	7.30	14.52	3.45	3.00	3.00	3.00	12.45	15.17
24	0.00	0.20	2.30	2.00	4.50	14.54	0.00	0.00	0.00	0.00	0.00	15.17
25	0.30	1.45	1.15	0.00	3.30	14.56	0.00	0.0 +	0.0 +	0.00	0.00+	15.17
26	0.00	1.45	2.10	1.00	4.55	14.57	0.00	0.40	0.45	0.35	2.00	15.16
27	0.00	0.00	0.00	0.00	0.00	14.58	0.30	2.00	2.45	1.45	7.00	15.16
28	0.45	2.50	2.20	0.05	6.00	15.00	1.00	1.30	3.00	2.30	8.00	15.15
29	3.20	2.15	0.45	0.00	6.20	15. 1	0.15	3.00	3.00	3.00	9.15	15.15
30	0.30	2.45	2.20	0.00	5.35	15. 3	3.00	3.00	3.00	3.15	12.15	15.15
31	0.00	0.00	0.00	0.00	0.00	15. 4	....	....	....	....	....	....
Total hours	39.15	52.35	51.05	43.15	185.10	453.29	34.35	42.15	42.15	39.40	158.35	457.03
Per cent of possible	29.3	46.5	54.9	32.3	40.8	....	24.8	46.9	46.9	28.6	34.7	....

SUNSHINE RECORD — (*Continued*).

	JULY.						AUGUST.					
	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.
	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.
1	1.20	0.0 +	0.0 +	0.00	1.20+	15.13	0.00	0.45	2.00	1.00	3.45	14.26
2	0.00	0.30	0.45	1.45	3.00	15.12	2.00	1.30	0.35	0.30	4.35	14.24
3	2.50	2.45	2.50	0.55	9.20	15.12	2.00	3.00	2.30	0.30	8.00	14.22
4	1.20	3.00	2.55	0.10	7.25	15.11	3.15	1.15	0.45	3.00	8.15	14.20
5	2.30	3.00	3.00	3.30	12.00	15.10	0.00	1.45	3.00	3.30	8.15	14.17
6	3.45	3.00	3.00	3.15	13.00	15. 9	3.15	3.00	3.00	3.40	12.55	14.15
7	3.40	3.00	3.00	2.30	12.10	15. 8	3.20	3.00	3.00	3.00	12.20	14.13
8	3.00	3.00	3.00	3.00	12.00	15. 7	2.40	2.00	1.50	0.10	6.40	14.11
9	3.15	3.00	2.45	3.10	12.10	15. 6	0.00	0.00	0.00	0.00	00.00	14. 8
10	3.40	2.35	2.30	2.25	11.10	15. 5	2.30	3.00	3.00	2.40	11.10	14. 6
11	0.00	0.30	2.15	4.00	6.45	15. 4	2.30	2.45	3.00	3.30	11.45	14. 3
12	3.30	2.30	2.45	3.00	11.45	15. 3	0.35	1.45	0.45	1.15	4.20	14. 1
13	2.15	2.00	1.40	2.00	7.55	15. 1	0.00	0.00	1.15	0.15	1.30	13.59
14	0.30	2.00	0.10	0.00	2.40	14.59	0.00	0.00	0.30	2.00	2.30	13.55
15	1.20	2.00	2.30	3.30	9.20	14.58	0.00	0.30	0.20	0.45	1.35	13.53
16	2.45	3.00	3.00	2.45	11.30	14.56	3.30	2.15	2.00	1.45	9.30	13.50
17	2.30	3.00	2.30	0.30	8.50	14.55	3.15	3.00	3.00	1.45	11.00	13.48
18	3.00	3.00	3.00	3.20	12.20	14.54	1.40	2.45	2.15	0.00	6.40	13.45
19	2.00	0.00	0.00	0.00	2.00	14.52	0.15	1.30	0.00	0.00	1.45	13.43
20	0.00	0.00	0.00	0.00	0.00	14.50	2.15	2.15	0.20	0.00	4.50	13.40
21	2.45	2.30	3.00	3.00	11.15	14.48	1.45	2.00	1.30	0.00	5.15	13.38
22	3.15	3.00	2.20	3.15	11.50	14.46	1.20	1.10	2.30	1.30	6.30	13.35
23	2.45	3.00	3.00	4.00	12.45	14.45	2.45	2.45	0.45	0.45	7.00	15.33
24	3.30	2.00	3.00	3.30	12.00	14.43	3.00	3.00	2.45	2.00	10.45	13.30
25	3.30	2.50	2.15	3.20	11.55	14.41	1.00	3.00	3.00	2.45	9.45	13.27
26	3.15	3.00	3.00	2.30	11.45	14.39	2.50	3.00	3.00	3.00	11.50	13.25
27	0.00	0.00	3.00	3.20	6.20	14.37	3.00	1.00	3.00	2.45	9.45	13.22
28	3.15	3.00	3.00	1.30	10.45	14.35	3.15	3.00	2.30	2.00	10.45	13.19
29	0.00	0.00	0.00	0.00	00.00	14.33	3.15	3.00	3.00	2.50	12.05	13.16
30	0.00	0.00	0.00	0.00	00.00	14.31	2.45	3.00	2.30	0.00	8.15	13.13
31	0.00	0.00	0.00	0.00	00.00	14.28	2.30	3.00	3.00	2.30	11.00	13.10
Total hours	65.45	61.10	64.10	64.10	255.15	462.11	60.25	63.55	60.35	49.20	234.15	428.47
Per cent of possible	47.6	65.8	69.0	46.5	55.2	......	49.8	68.7	65.1	40.6	54.6	......

SUNSHINE RECORD — (*Continued*).

	SEPTEMBER.						OCTOBER.					
	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sun-set.	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sun-set.
	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.
1	1.45	3.00	1.30	0.00	6.15	13. 8	1.10	2 30	0.20	0.00	4.00	11.43
2	1.00	3.00	3.00	3.15	10.15	13 5	0.00	0.00	1.15	1.45	3.00	11 40
3	2.20	3.00	2.30	0.00	7.50	13. 2	0.00	0.00	0.00	0.0 +	0.00+	11.38
4	3.00	1.30	1.45	0.00	6.15	13. 0	0.00	0.00	0.00	0.00	00.00	11.35
5	0.30	1.30	1.45	0.00	3.45	12.57	0.00	0.00	0.00	0.00	00.00	11.32
6	0.00	0.00	0.00	0.45	0.45	12.54	0.00	0.00	0.00	0.00	00.00	11.30
7	0.00	0.00	0.00	0.00	0.00	12.51	0.00	0.0 +	0.00	0.00	00.00+	11.27
8	1.00	0.30	1.15	1.00	3.45	12.49	0.00	2.30	2.50	1.20	6.40	11.24
9	0.00	2.55	3.00	2.25	8.20	12.46	0.00	0.00	0.00	0.00	00.00	11.21
10	0.00	2.30	3.00	2.00	7.30	12.43	2.20	3.00	2.45	1.45	9.50	11.18
11	1.00	3.00	3.00	2.00	9.00	12.40	0.00+	0.45	1.30	1.00	3.15+	11.15
12	2.30	3.00	3.00	2.00	10.30	12.38	0.00	0.00	0.00	0.00	0.00	11.13
13	0.00	0.30	1.30	1.00	3.00	12.35	0.00	0.00	0.00	0.00	0.00	11.10
14	0.45	1.45	1.00	1.00	4.30	12.32	1.15	2.45	3.00	1.45	8.45	11. 7
15	2.30	2.45	0.15	2.30	8.00	12.28	2.30	3.00	3.00	2.40	11.10	11. 4
16	0.00	0.00	0.00	0.00	0.00	12.26	2.30	3.00	3.00	2.30	11.00	11. 1
17	0.00	0.00	0.00	0.00	0.00	12.23	0.15	0.00	0.50	0.00	1.05	10.58
18	0.15	2.30	1.00	0.00	3.45	12.20	2.20	1.10	2.30	2.20	8.20	10.55
19	0.00	1.00	0.45	0.30	2.15	12.17	1.00	3.00	3.00	1.15	8.15	10.52
20	0.00	0.00	0.00	0.00	0.00	12.14	0.00	0.00	0.00	0.00	00.00	10.50
21	0.00	0.00	0.00	0.00	0.00	12.12	1.30	2.00	1.45	2.00	7.15	10.47
22	2.30	3.00	3.00	2.00	10.30	12. 9	1.00	0.00+	0.00+	0.00	1.00+	10.45
23	2.20	3.00	3.00	2.30	10.50	12. 6	2.15	3.00	3.00	2.30	10.45	10.42
24	2.15	3.00	1.30	0.05	6.50	12. 3	2.15	3.00	3.00	2.15	10.30	10.36
25	2.30	3.00	1.00	0.00	6.30	12. 1	0.00	0.00	0.00+	0.30	0.30+	10.37
26	0.00	0.00	0.30	2.15	2.45	11.58	0.00	0.00	0.00	0.00	00.00	10.34
27	2.30	2.15	0.30	0.00	5.15	11.55	0.00	0.00	0.00	0.00	00.00	10.32
28	0.00	1.40	1.40	1.00	4.20	11.51	0.00	0.00	0.00	0.00	00.00	10.29
29	2.20	3.00	3.00	1.00	9.20	11.49	0.00	0.00	0.00	0.00	00.00	10.26
30	0.00	0.00	0.00	0.00	00.00	11.46	1.30	0.00	0.00	0.00	1.30	10.24
31	......	......	......	......	......	......	0.00	0.00	0.00	0.00	00.00	10.21
Total hours	31.00	51.20	42.25	27.15	152.00	373.38	21.50	29.40	31.45	23.35	106.50	341.49
Per cent of possible	32.0	57.0	47.1	28.1	40.7	......	28.0	31.9	34.1	30.3	31.3	....

SUNSHINE RECORD — (*Concluded*).

DATE.	NOVEMBER.						DECEMBER.					
	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.
	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.
1	0.00	0.00	0.00	0.00	00.00	10.19	1.30	3.00	3.00	1.20	8.50	9.17
2	0.00	0.00	0.00	0.00	00.00	10.16	0.00	0.00	0.00	0.00	00.00	9.16
3	0.00	0.00	1.00	1.45	2.45	10.14	0.00	0.00	0.00	0.00	00.00	9.15
4	2.15	2.45	2.45	1.00	8.45	10.12	1.20	1.30	2.40	1.30	7.00	9.14
5	0.00	0.00	0.00	0.00	00.00	10.10	0.00	0.00	0.00	0.00	0.00	9.13
6	0.45	3.00	2.45	2.00	8.30	10. 8	0.00	2.00	1.30	0.05	3.35	9.11
7	2.00	3.00	3.00	1.05	9.05	10. 5	1.25	3.00	3.00	1.15	8.40	9.10
8	0.00	0.00	0.00	0.00	00.00	10. 2	0.00	0.00	0.00	0.00	0.00	9.10
9	0.00	0.00	0.00	0.00	00.00	10.00	?	3.00	3.00	?	*8.00+	9. 9
10	0.00	0.45	1.20	1.10	3.15	9.57	0.00	0.00	0.00	0.00	00.00	9. 8
11	0.00	0.00	0.00	0.00	00.00	9.55	0.00	0.00	0.00	0.00	00.00	9. 7
12	0.45	2.00	2.30	0.45	6.00	9.53	0.00	1.20	2.00	0.00	3.20	9. 6
13	0.00	0.00	0.00	0.00	00.00	9.50	0.00	0.00	0.00	0.00	0.00	9. 6
14	0.00	1.00	0.00	0.00	1.00	9.48	0.00	0.00	0.00	0.00	0.00	9. 6
15	0.00	0.0 +	0.45	0.15	1.00+	9.46	0.00	0.00	0.00	0.00	0.00	9. 6
16	1.15	3.00	3.00	1.45	9.00	9.44	0.00	0.00	0.00	0.00	0.00	9. 5
17	1.45	3.00	3.00	1.15	9.00	9.42	0.00	0.00	0.00	0.00	0.00	9. 5
18	0.00	0.00	0.00	0.00	00.00	9.39	0.00	0.00	0.00	0.00	0.00	9. 5
19	0.00	0.00	0.00	0.00	00.00	9.38	†......	......	......	......	......	9. 4
20	0.00	0.00	2.15	1.20	3.35	9.36	0.10	2.10	2.00	0.20	4.40?	9. 4
21	0.00	0.00	0.00+	0.00	00.00+	9.34	0.00	0.00	0.00	0.00	00.00	9. 4
22	0.00	0.00	0.00	0.00	0.00	9.32	0.00	0.00	0.00	0.00	00.00	9. 4
23	0.00	0.00	0.00	0.00	0 00	9.30	†......	......	......	......	......	9. 4
24	0.00	0.0 +	0.10	0.00	0.10+	9.29	0.00	0.45	1.45	1.00	3.30?	9. 5
25	0.00	0.00	0.00	0.00	00.00	9.27	1.20	3.00	3.00	1.30	8.50	9. 5
26	0.00	0.30	0.00	0.00	00.30	9.25	0.15	1.15	0.30	0.00	2.00	9. 5
27	0.00	0.00	0.00	0.00	00.00	9.24	0.00	0.00	0.00	0.00	00.00	9. 6
28	0.00	0.00	0.00	0.00	00.00	9.23	0.00	0.00	0.00	0.00	00.00	9. 6
29	0.00	0.00	0.00	0.00	00.00	9.20	0.00	0.00	0.00	0.00	00.00	9. 7
30	0.00	0.00	1.30	1.15	2.45	9.19	0.20	0.10	2.00	0.20	2.50	9. 7
31	......	......	......	......	......	......	1.30	3.00	3.00	1.30	9.00	9. 8
Total hours of sunshine	8.45	19.00	24.00	13.35	65.20	293.17	7.50	21.10	24.25	8.50	62.15	283. 1
Per cent of possible sunshine	15.4	21.1	26.7	24.0	22.3	......	16.5	22.8	26.1	18.2	22.0	....

* Record lost, and this from photographic record. † This record for two days.

MONTHLY SUMMARY OF SUNSHINE RECORD, MAY 1, 1885, TO OCTOBER 1, 1888.

		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1885....	Hours	......	......	......	......	165.2	237.5	284.75	163.5	206.75	134.5	53.00	50.00
	Per cent of possible	......	......	......	......	36.4	52.0	53.8	38.1	55.3	39.3	18.1	17.6
1886....	Hours	43.25	80.00	83.25	144.75	235.75	252.25	243.25	240.25	200.5	142.75	102.00	68.5
	Per cent of possible	14.30	26.7	22.3	36.3	51.9	54.2	52.6	56.0	53.7	41.8	34.8	24.2
1887....	Hours	44.00	61.50	110.75	159.00	265.00	217.75	267.5	235.75	......	......	......	......
	Per cent of possible	14.5	18.2	29.7	39.9	58.4	47.6	57.9	55.0	......	......	......	......
1888....	Hours	......	......	......	......	......	207.42	270.67	200.83	157.08	......	......	......
	Per cent of possible	......	......	......	......	......	45.7	58.9	46.8	42.04	......	......	......
1889....	Hours	65.83	84.58	124.42	164.75	185.17	158.58	255.25	234.25	152.0	106.83	65.33	62.25
	Per cent of possible	22.4	28,6	33.6	41.0	40.8	34.7	55.2	54.6	40.7	31.3	22.3	22.0

READINGS OF THE MAXIMUM AND MINIMUM THERMOMETERS AT 7 A. M.

1889.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER		OCTOBER.		NOVEMBER.		DECEMBER.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1....	44.5	31.0	36.0	15.0	33.0	27.3	35.0	26.0	51.2	37.0	72.0	51.5	83.0	66.7	79.0	66.0	77.0	50.0	63.8	56.0	46.5	40.0	32.5	19.5
2....	41.0	31.5	25.0	11.0	37.0	27.0	32.3	28.8	47.2	36.8	60.0	54.0	79.7	67.0	78.5	63.5	79.7	54.0	68.7	42.8	49.0	39.5	42.5	20.0
3....	34.0	28.0	35.0	24.0	38.0	32.0	41.0	31.0	44.8	35.6	....	51.5	77.2	67.0	83.0	65.2	83.0	62.8	51.2	36.2	61.5	46.5	45.0	28.0
4....	50.0	28.5	26.6	—7.0	41.0	33.0	57.0	33.0	49.0	34.0	....	52.0	85.0	61.0	81.0	57.3	84.0	....	56.2	46.2	61.7	37.0	28.2	8.0
5....	46.5	30.5	34.0	—5.0	39.0	31.0	40.0	27.0	62.6	33.8	....	46.0	75.3	55.3	78.2	60.0	....	....	46.0	38.5	52.5	33.0	25.0	8.0
6....	37.5	30.5	36.0	—2.0	41.0	27.4	45.3	30.0	74.0	46.0	....	....	71.6	50.5	70.6	51.0	....	58.0	50.0	44.5	38.0	33.0	37.0	24.0
7....	?	32.0	9.5	—2.0	39.5	27.0	48.0	28.0	77.5	52.2	....	....	73.2?	60.2?	75.7	51.2	....	50.0	45.5	36.2	44.0	32.2	36.0	30.0
8....	34.4	31.5	17.0	—1.0	32.0	20.6	52.0	29.0	82.0	52.0	....	56.6	84.2	56.2	73.7	50.5	....	60.3	41.0	35.5	55.0	33.5	52.3	33.0
9....	38.0	32.0	27.0	19.5	24.7	22.0	55.0	35.0	87.0	51.0	66.8	59.0	86.0	69.5	76.0	57.6	....	59.5	49.0	35.0	47.8	37.0	51.0	35.0
10....	50.5	30.5	28.0	18.5	27.5	?	60.8	32.5	89.5	65.0	83.8	62.5	90.0	68.5	76.0	61.4	....	57.0	54.7	40.0	50.0	40.0	55.2	31.0
11....	31.5	24.0	31.0	16.0	28.0	19.3	52.0	31.4	84.5	58.5	82.0	56.0	90.7	67.6	75.3	54.2	77.0	58.5	52,5	37.5	52.6	40.0	46.5	30.5
12....	30.0	23.0	31.5	14.0	37.0	19.5	69.0	38.5	69.0	51.0	63.0	51.7	78.4	62.6	66.0	51.0	77.0	55.4	61.0	41.0	....	....	49.0	35.0
13....	32.0	21.5	23.0	5.0	40.5	28.5	51.0	30.0	70.0	43.5	75.0	52.0	82.0	62.0	72.0	55.6	79.0	60.0	56.0	37.8	55.0	39.5	49.0	33.5
14....	37.5	21.5	22.0	5.0	51.0	24.5	37.0	29.0	70.0	51.0	79.6	62.0	87.4	62.2	76.0	55.5	79.0	59.0	56.2	35.5	51.7	44.0	48.7	19.0
15....	25.5	16.0	15.5	5.0	35.0	24.5	45.6	26.5	69.0	46.0	81.0	65.0	74.0	55.0	....	53.5	79.0	64.0	48.2	36.0	50.7	?	25.0	19.0
16....	33.0	17.0	27.0	8.8	47.0	29.0	56.0	30.7	66.8	48.5	80.0	63.3	69.0	56.8	65.0	50.3	80.0	65,5	52.0	37.0	29.0	33.0	36.0	21.2
17....	44.0	....	38.5	23.5	48.6	27.5	62.8	33.8	80.0	57.0	78.5	64.0	77.8	56.0	72.0	50.3	68.0	54.0	60.3	37.0	34.0	17.8	39.0	24.0
18....	55.0	31.7	37.0	28.0	46.0	28.7	67.0	39.0	91.8	63.0	68.8	48.0	78.0	61.0	70.0	51.5	64.0	49.5	64.5	36.6	39.8	19.0	43.2	35.0
19....	36.0	10.5	41.0	14.5	40.0	29.5	69.0	47.2	90.0	60.3	72.5	57.5	85.0	67.0	75.5	55.0	62.0	43.8	57.0	33.0	41.0	35.0	47.5	42.0
20....	11.0	5.0	22.0	14.0	42.0	30.0	84.0	51.0	75.0	59.5	73.2	54.0	76.0	63.0	77.8	60.3	57.0	47.0	61.2	47.0	48.0	41.?	53.0	36.0
21....	29.0	7.0	22.0	8.0	37.0	31.5	62.0	41.8	65.0	55.0	77.2	57.0	67.3	58.0	79.5	60.4	57.0	47.0	48.0	26.5	49.3	38.0	60.2	34.5
22....	28.0	18.0	34.0	9.0	40.0	28.5	71.8	33.6	67.6	45.0	85.0	57.0	75.8	55.0	86.6	59.0	49.5	40.0	48.0	28.5	50.2	38.2	40.5	28.0
23....	30.0	17.0	42.0	—4.0	51.2	31.3	45.0	26.3	55.5	41.6	70.5	49.0	81.5	62.0	74.2	53.0	55.8	40.0	43.0	22.8	46.3	38.5	51.0	27.5
24....	40.0	19.0	4.0	—7.0	57.0	31.5	62.5	33.5	67.6	47.0	68.0	47.0	75.0	55.0	77.0	56.3	72.5	50.6	43.0	21.2	43.8	33.8	42.0	30.5
25....	43.5	21.0	11.5	4.0	61.5	29.5	70.3	46.6	68.8	46.5	67.0	51.6	75.0	53.0	75.6	53.0	....	....	47.0	24.0	48.7	36.0	60.5	35.0
26....	38.5	21.0	18.5	4.0	36.0	20.5	58.5	43.0	65.5	43.7	72.5	56.0	75.0	62.0	77.0	50.5	72.2	52.5	47.8	23.0	48.5	28.5	56.2	33.0
27....	42.0	28.0	27.0	10.0	44.6	24.0	49.0	42.8	63.0	44.0	80.0	61.0	80.0	56.0	78.0	55.5	55,0	42.4	52.5	43.0	39.0	28.0	35.0	26.0
28....	34.0	22.5	33.0	30.0	61.8	31.0	62.0	48.0	55.0	49.5	78.3	63.5	76.5	61.0	78.0	53.5	53.0	42.3	50.0	41.5	40.5	31.0	36.0	25.5
29....	34.0	10.5	....	....	36.0	26.0	52.7	46.0	53.4	32.0	77.4	58.0	85.0	69.5	79.5	52.0	59.0	40.0	41.0	37.2	40.5	26.0	37.7	31.0
30....	19.0	10.0	....	....	44.0	18.5	51.2	39.0	59.0	45.0	80.4	58.0	81.2	66.0	80.0	52.0	66.0	43.0	41.5	33.5	29.0	18.5	50.5	27.0
31....	29.5	16.0	....	....	30.0	22.0	....	....	79.0	59.0	....	....	78.0	63.0	86.7	55.0	....	....	42.5	33.5	....	....	28.0	14.0

READINGS OF THE

1889	JANUARY.			FEBRUARY.			MARCH.			APRIL.			MAY.			JUNE.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	32.0	37.0	34.0	16.0	17.0	12.0	28.0	35.5	34.0	31.0	31.0	30.3	40.0	46.0	41.0	51.8	54.0	52.2
2	32.0	33.0	33.0	25.0	30.5	28.5	35.0	37.0	36.0	31.0	37.0	36.0	38.0	44.0	41.7	54.0	58.5	60.4
3	29.7	41.5	40.0	26.0	14.5	7.0	34.0	37.0	37.0	37.0	43.6	43.0	39.7	47.0	43.3	56.8	67.0	61.0
4	32.5	45.5	38.5	—3.0	18.0	25.0	33.2	37.2	36.0	35.0	35.5	35.0	47.0	59.0	60.0	57.0	68.2	57.4
5	31.2	......	......	33.0	35.5	23.0	32.0	34.0	34.0	30.6	41.0	40.5	58.5	71.8	68.2	52.6	57.6	56.2
6	33.5	33.0	33.5	......	3.0	1.0	28.0	36.0	35.5	32.0	45.5	40.5	51.5	73.0	73.0	47.7	59.4	58.0
7	33.0	33.0	33.5	9.5	14.5	14.5	30.0	30.5	27.0	34.0	50.0	45.5	58.0	79.5	78.5	57.0	71.0	63.0
8	33.0	34.0	34.0	13.5	21.0	27.0	21.5	23.0	23.5	36.0	51.0	46.5	58.5	83.0	82.0	59.0	64.0	64.6
9	38.0	44.5	42.0	26.5	28.0	25.0	23.0	26.0	26.0	39.8	58.0	55.0	64.0	85.0	83.0	66.4	80.0	71.0
10	31.0	30.0	29.0	21.0	27.5	25.0	22.0	25.5	25.5	36.3	48.0	45.2	71.5	83.0	72.5	68.0	72.0	67.5
11	25.0	29.0	27.0	24.5	29.0	30.5	20.0	30.8	30.0	38.5	68.2	60.0	59.0	64.0	65.3	61.0	63.0	60.4
12	25.0	27.5	26.0	15.5	18.8	14.0	35.0	37.4	35.0	51.0	50.0	46.0	57.0	68.6	64.5	61.6	71.2	71.3
13	22.5	35.0	29.5	6.0	8.5	7.8	37.3	48.0	40.0	31.5	34.0	37.0	51.0	67.5	60.4	62.5	77.0	73.5
14	23.0	25.0	24.5	11.2	18.0	15.0	26.0	31.0	31.5	33.0	44.0	41.0	59.7	65.6	59.5	64.5	78.2	79.0
15	17.0	28.0	29.0	9.0	23.0	18.0	32.5	44.0	41.8	33.0	52,0	48.0	49.0	60.8	59.5	67.5	72.0	72.0
16	33.0	39.0	41.0	26.6	33.2	34.0	30.7	45.5	36.0	37.7	59.0	59.0	66.0	78.5	66.2	65.0	78.5	66.2
17	......	......	......	37.5	36.5	36.0	30.0	46.0	36.0	39.0	60.5	62.0	67.0	88.5	85.5	64.6	68.0	63.6
18	32.0	30.0	28.0	29.0	31.0	38.0	30.0	35.3	34.5	47.2	66.5	65.0	67.0	85.8	83.3	56.5	69.0	71.4
19	12.0	9.6	11.0	16.0	19.8	18.0	30.6	40.6	36.0	51.0	78.8	71.0	65.0	74.5	70.0	58.0	57.2	72.4
20	9.0	21.0	23.0	16.0	19.8	15.0	33.0	35.0	35.0	59.0	60.0	62.0	61.2	64.0	64.2	64.2	74.0	73.8
21	28.0	24.5	23.0	10.0	25.0	31.0	32.5	38.0	34.5	50.0	58.0	46.7	57.0	64.0	53.5	64.5	83.6	68.3
22	19.0	28.0	22.4	28.7	41.7	19.0	31.5	47.8	39.5	36.5	42.0	40.0	47.0	53.5	49.0	60.8	60.3	60.0
23	20.0	33.0	34.5	—2.5	3.0	......	32.2	54.0	48.0	33.5	52.3	57.0	43.0	51.0	53.0	56.0	66.7	63.8
24	34.0	36.0	34.5	—5.0	9.0	9.5	45.0	56.0	54.0	55.2	64.4	64.0	52.5	61.6	66.0	51.5	64.7	64.0
25	22.0	35.0	34.0	5.0	16.0	......	31.0	35.0	28.0	54.0	58.5	47.0	48 0	53.2	50.0	56.0	67.0	69.0
26	30.0	38.6	35.0	10.0	21.0	22.0	24.3	39.0	40.5	44.0	48.0	46.7	46.0	60.0	58.0	62.0	73.5	66.2
27	32.0	34.0	32.5	27.0	31.0	32.0	39.5	55.2	47.0	48.2	59.2	53.2	50.7	50.8	53.0	65.0	74.5	77.0
28	24.0	23.5	19.5	31.0	32.0	......	31.7	......	31.0	51.0	51.5	50.8	50.0	52.0	45.0	67.2	73.6	74.0
29	11.7	13.0	13.5	......	......	......	29.0	37.5	25.6	46.5	48.7	43.7	41.7	52.0	53.6	62.0	77.2	74.5
30	19.0	28.0	25.0	......	......	......	21.0	25.2	26.2	40.0	44.0	40.2	59.0	73.0	71.0	68.0	79.5	80.0
31	27.0	34.0	34.0	......	......	......	28.0	32.5	34.0	.....	.....	.....	65.8	69.0	63.0	.....	.....	.....

STANDARD AIR THERMOMETER.

JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
71.5	79.0	74.0	68.0	72.5	76.0	55.0	75.7	75.0	56.2	68.0	55.8	41.0	42.0	40.5	20.7	41.0	34.7
67.5	74.3	74.2	68.2	81.0	77.8	65.0	78.0	76.5	43.0	45.0	43.0	49.0	59.0	55.5	39.2	44.5	41.5
73.0	85.0	80.0	71.0	77.0	73.0	66.0	80.0	79.0	43.0	52.3	56.0	47.0	48.0	44.0	29.0	23.2	17.2
62.5	72.3	71.0	65.0	74.0	70.0	.....	......	......	45.5	44.0	42.5	38.6	50.2	44.0	9.2	16.0	14.0
60.8	69.0	66.0	61.0	67.5	66.0	......	80.5	76.0	39.5	46.2	48.0	34.0	39.0	36.5	24.6	30.2	32.5
62.0	73.0	73.2	61.0	71.4	68.0	58.0	58.0	61.0	45.5	42.0	39.5	36.0	42.5	37.8	33.5	35.0	31.0
66.0	81.0	81.0	62.0	72.3	68.8	53.0	64.7	65.0	37.0	41.0	38.0	34.8	51.0	48.0	35.5	48.0	39.5
74.0	84.0	81.2	58.0	73.0	71.0	63.0	69.0	69.2	37.2	45.0	43.0	37.5	47.0	47.0	36.5	41.0	45.6
75.4	88.0	84.0	66.0	76.0	70.0	62.5	76.0	71.0	43.5	52.0	52.3	46 0	50.0	47.0	40.0	55.0	42.5
77.8	88.0	82.0	65.0	73.0	68.8	60.0	75.0	70.0	41.0	49.0	44.0	40.5	50.0	42.0	32.0	37.2	37.8
71.0	76.6	77.0	59.0	64.0	62.0	69.0	76.0	69.0	42.5	56.0	50.0	44.0	47.0	46.0	46.5	43.0	41.5
71.0	78.0	76.4	56.0	71.0	64.6	60.5	75.0	72.0	43.0	54.6	45.0	41.0	53.0	49.0	36.5	42.5	36.5
70.0	83.2	80.5	60.0	66.0	69.2	64.0	75.0	70.0	39.0	41.0	42.0	48.0	51.0	48.0	48.0	46.0	36.0
65.0	73.0	65.0	64.3	66.7	71.5	67.5	76.3	74,0	38.0	47.0	43.0	47.0	48.8	42 0	20.5	22.5	21.0
57.0	65.0	66.0	54.0	62.2	62.5	68.0	77.0	74.0	37.7	51.2	45.0	27.0	27.2	27.8	22.0	28.0	32.0
62.3	75.5	73.0	55 3	68.5	64.5	66.0	60.5	57,2	39.0	58.0	47.0	24.0	30.2	25.4	34.8	38.3	37.0
68.7	77.5	73.0	58.5	67.0	64.0	54.5	58.0	64.0	42.5	62.0	55.0	20.0	38.0	39.2	36.0	41.0	39.5
67.0	81.5	80.8	55.5	73.0	69.5	50.3	56.0	52.0	40.0	53.3	45.0	35.5	37.0	39.7	43.5	45.5	46.0
71.3	69.5	70.0	61.0	77.0	72.0	50.0	55.5	52.5	36.0	57.7	49.0	40.0	42.0	47.0	42.7	50.0	47.0
63.5	65.0	65.3	67.0	77.5	75.0	52.0	56.0	53.0	48.0	43.0	38.0	43.8	47.0	41.7	37.0	52.7	52.2
62.0	71.2	71.0	70.0	83.0	78.0	47.5	48.5	48.0	29.0	45.5	36.0	41.5	49.8	45.0	35.0	35.7	32.0
63.0	77.0	74.5	64.0	72.0	70.0	43.9	53.0	50.0	30.0	42.8	37.0	39.8	45.8	44.7	40.5	50.2	40.0
66.0	73.5	70.0	61.0	75.0	72.0	42.5	60.0	57.0	23.5	36.0	30.0	41.0	42.5	40.0	34.5	37.0	33.5
61.4	68.7	67.0	62.5	74.0	67.0	53.0	69.0	63.0	24.8	44.0	40.0	35.5	45.0	48.0	36.7	39.2	42.0
61.0	72.0	67.8	58.2	74.2	69.4	51.0	68.0	62.0	34.8	41.0	44.0	36.5	37.0	33.5	56.0	54.8	40.0
62.0	77.0	75.0	55.7	75.0	74.0	54.0	52.0	50.0	43.5	51.0	47.0	32.0	38.2	33.5	46.0	41.0	35.0
61.8	67.0	75.6	60.5	73.5	74.5	44.0	50.0	47.5	46.0	49.0	46.2	31.0	36.0	39.0	27.0	29.2	27.0
72.8	82.5	80.0	59.5	76.2	75.5	44.5	56.2	49.0	41.0	40.0	38.0	38.0	36.0	34.2	35.0	35.5	33.2
74.2	80.0	76.3	57.0	77.0	75.0	42.5	60.0	59.5	38.8	40.0	38 5	26.0	27.0	25.8	37.2	45.5	44.7
67.0	76.0	75.0	59.5	84.0	75.0	58.0	61.0	60.7	34.0	40.0	39.0	25.0	29.8	26.5	27.5	27.0	24.5
66.3	77.0	74.0	61.0	75.5	67.7	......	......	......	42.5	45.0	46.0	......	......	......	14.5	25.0	29.0

READING OF SOIL THERMOMETERS.

1889.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
April 1	....	...	....	32.7	33.5	33.5	33.0	33.5	34.0	33.0	33.5	33.5	34.5	33.5	33.5	34.5	34.5	34 5	36.5	36.5	36.2
2	....	....	....	33.0	39.8	38.5	33.5	37.5	39.0	33.7	35.0	38.8	33.7	34.0	37.0	34.5	35.0	36.0	36.0	36.2	36.3
3	....	....	...	36.0	41.8	43.5	36.0	40.0	44.0	36.0	38.8	43.8	35.5	37.0	41.0	36.0	37.0	39.0	37.0	37.0	37.0
4	....	....	....	36.0	40.8	38.0	36.2	40.0	40.0	36.6	39.0	40.0	36.5	38.0	39.5	38.0	38.0	39.0	38.0	38.0	38.0
5	...	....	....	33.0	47.5	43.0	34.0	47.0	45.3	34.6	44.0	46.0	35.5	37.5	44.0	37.0	37.5	41.5	38.0	38.0	38.3
6	....	....	....	34.0	50.8	44.5	34.8	49.0	46.5	35.5	46.0	46.5	37.0	40.0	44.5	38.5	39.0	42.5	39.0	39.0	39.0
7	....	....	....	34.0	55.0	52.0	34.0	53.5	54.0	35.0	47.5	53.0	36.5	40.0	48.3	38.5	39.0	44.0	39.6	39.5	39.5
8	....	....	49.0	35.6	58.0	53.0	36.0	55.5	55.6	36.6	49.7	55.0	38.5	42.0	60.5	40.0	40.5	46.0	40.6	40.5	40.8
9	43.0	76.0	54.0	41.0	58.0	54.5	41.7	56.2	56.0	42.0	51.4	55.0	42.0	41.5	51.0	42.5	43.0	47.5	41.8	41.8	42.0
10	41.5	75.0	51.0	38.5	57.5	52.6	39.8	56.5	55.0	40.5	51.7	55.0	42.0	45.5	51.5	44.0	44.0	48.0	43.0	42.8	43.0
11	39.0	73.0	56.0	38.0	61.0	55.2	39.5	56.0	56.0	40.0	51.5	55.0	41.5	45.5	51.0	43.0	44.0	48.0	43.5	43.2	43.0
12	50.0	53.0	48.0	49.0	51.0	48.0	48.8	50.8	49.0	48.6	50.0	49.4	47.7	48.0	48.5	47.0	47.0	47.5	44.0	44.5	44.5
13	38.0	48.0	41.0	38.0	44.6	43.0	39.0	43.7	45.0	40.0	43.0	45.5	42.0	42.0	44.6	44.0	43.0	44.0	44.4	44.0	43.7
14	36.0	68.0	50.0	34.4	54.0	51.0	35.0	50.4	53.0	36.0	45.7	52.5	38.0	41.0	49.0	40.5	41.0	45.5	43.0	42.8	42.7
15	40.0	77.5	53.0	36.6	57.3	36.6	37.0	54.6	56.0	37.0	49.5	56.0	39.5	43.5	51.5	41.5	42.5	47.5	43.0	43.0	43.0
16	40.0	79.0	56.0	39.2	59.3	57.0	39.8	57.0	58.7	40.0	52.0	58.2	41.5	46.0	54.0	40.0	44.5	49.5	44.0	44.0	44.2
17	43.0	81.5	60.5	41.5	61.5	67.0	42.0	58.7	62.0	42.3	54.0	61.3	44.0	48.0	56.5	46.0	46.0	50.5	45.0	45.0	45.0
18	50.0	86.0	64.0	48.8	66.5	62.3	49.0	62.0	64.3	49.0	57.6	63.0	49.0	51.5	58.0	49.0	49.5	53.0	46.2	46.6	46.8
19	52.0	86.0	68.0	49.6	69.0	67.3	50.0	65.0	67.5	50.0	61.0	66.3	50.0	54.5	61.5	50.5	51.5	56.5	48.0	48.0	48.5
20	59.5	63.5	63.0	56.6	60.7	63.5	56.0	60.3	64.8	56.0	59.5	64.8	55.0	56.5	60.0	54.5	54.5	56.0	49.8	50.0	50.0
21	52.5	78.0	53.0	49.6	65.2	55 5	49.8	63.7	58.5	49.8	60.5	59.0	50.5	54.7	57.0	52.0	51.2	55.0	50.0	49.5	50.0
22	43.0	67.0	47.0	41.5	52.0	50.5	43.0	50.0	53.0	44.0	48.5	53.5	46.5	47.0	51.5	49.0	48.0	50.0	49.4	49.0	48.0
23	38.0	72.0	55.5	38.0	57.3	55.5	38.8	52.0	56.0	40.0	49.0	56.0	42.0	45.5	52.5	45.0	45.5	50.0	47.7	47.0	47.0
24	53.5	74.0	61.5	51.0	62.0	59.5	50.0	59.0	59.0	49.6	56.5	58.5	49.0	52.0	55.5	49.0	49.0	52.5	47.5	47.6	48.0
25	54.0	61.5	52.0	52.8	58.0	52.0	52.5	56.5	53 0	52.5	55.2	54.0	51.5	53.0	53.5	51.5	51.5	52.5	48.8	49.0	49.0
26	48.0	60.0	51.5	47.0	55.0	51.5	47.5	54.0	52.8	48.0	52.8	53.0	48.5	55.5	52.0	49.5	50.0	51.0	49.0	48.8	48.8
27	50.0	66.0	55.5	49.0	61.5	55.4	49.0	58.8	56.0	49.0	55.8	56.0	48.5	51.5	54.5	49.0	50.0	52.5	48.6	48.8	48.8
28	52.6	55.0	52.0	51.8	53.8	52.0	51.8	53.0	52.6	51.8	52.8	52.0	51.5	51.5	52.0	51.5	51.5	52.0	50.0	50.0	49.8
29	47.5	63.0	46.0	47.0	53.0	46.8	47.6	52.0	48.2	48.5	51.0	49.5	49.0	48.5	50.0	50.0	50.0	50.5	49.8	49.6	49.2
30	42.5	50.0	42.0	42.5	47.0	42.0	43.0	46.2	44.3	44.0	46.0	45.3	45.3	45.5	46.0	47.5	47.0	47.0	48.8	48.5	48.0

READING OF SOIL THERMOMETERS — (*Continued*).

1889.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
May 1	42.0	53.0	48.0	41.6	51.0	48.0	40.4	49,5	49.0	41.0	48.0	49.4	42.5	45.5	48.5	45.0	45.5	48.0	47.5	47.0	47.0
2	42.0	52.0	45.0	42.0	49.0	45.5	42.0	48.0	46.0	43.0	47.0	46.5	44.0	45.3	46.0	45.5	45.5	46.5	47.0	47.0	46.8
3	43.0	70.5	49.5	42.0	55.6	50.5	42.2	52.6	52.0	42.6	50.3	52.5	43.2	46.5	51.0	45.0	45.5	48.0	46.5	45.4	46.8
4	47.0	81.5	58.0	44.0	59.6	56.0	43.2	55.0	56,5	43.0	52.3	56.0	43.8	47.2	53.0	45.5	46.5	50 5	47.0	47.0	47.0
5	76.0	89.0	66.0	51.2	68.0	65.0	49.5	64.0	65.6	48.5	60.5	64.5	48.0	53.0	59.0	49.0	50.5	54.5	48.0	48.4	49.0
6	55.0	96.0	68.0	51.0	72.0	68.0	50.5	66.5	69.0	50.5	63.0	67.8	51.0	55.5	63.0	52.0	52.5	58.0	50.0	50.0	50.5
7	60.0	99.0	76.0	55.7	75.0	73.2	55.0	70.5	73.7	54.6	67.0	72.5	54.5	59.8	66.5	54.5	55.5	60.5	52.0	52.0	52.5
8	63.0	114.0	81.0	58.0	80.5	77.8	58.0	76.0	78,8	57.7	72.0	78.0	57.5	63.0	71.0	57.5	58.5	64.5	53.8	54.0	54.5
9	67.0	161.0	83.0	62.0	80:0	79.6	61.5	76.0	79.8	61.0	73 0	78.5	61.0	65.5	72.0	60.7	61.5	66.0	56.0	56.0	56.5
10	71.0	94.0	76.0	67.6	81.5	74.0	66.8	77.5	75.0	66.0	74.0	75.0	64.5	67.0	71.0	63.5	63.5	66.5	57.8	58.0	58.0
11	61.0	105.5	72.0	60.5	73.0	73 0	61.5	71.0	74.3	62.0	68.5	74.4	62.5	64.0	70.0	62.5	62.0	65.5	58.5	58.5	58.0
12	66.0	100.0	69.5	60.5	77.0	72 2	60.0	74.0	73.7	60.0	71.0	73.6	60.0	64.5	69.5	61.0	61.5	65.0	58.6	58.0	58.0
13	60.0	77.5	62.0	56.6	70.0	61.3	56.0	67.5	63.0	56.0	65.6	63.6	57.0	61.0	62 5	59.5	59.5	61.5	58.3	58.0	57.6
14	62.5	85.0	63.5	59.5	69.0	65.0	58.9	67.0	66.5	59.2	65.0	66.3	58.5	61.5	64.0	59.0	60.0	61.5	57.0	57.3	57.0
15	55.0	96.0	68.0	53.8	72.6	68.0	53.8	69.7	69.0	54.2	66.0	69.0	55.5	60.0	66.0	57.5	58.0	62.5	57.0	57.0	57.0
16	67.0	105.0	74.0	61.3	80.5	73.0	60.0	77.5	74.5	59.5	72.8	74.0	59.0	64.5	70.0	59.5	61.0	65.5	57.8	57.8	58.0
17	74.0	114.0	85.5	64.0	84.0	82.0	63.0	81.0	83.5	62.0	76.0	81.5	61.5	67.5	75.0	62.0	63.0	69.0	59.0	59.0	59.5
18	71.0	106.0	80.5	67.5	85.0	80.5	67.0	82.0	81.3	66.5	78.0	81.0	66.0	70.5	76.5	66.0	66.5	71.0	61.0	61.0	61.3
19	68.0	79.0	70.0	66.0	73.0	70.0	65.5	71.5	71.0	65.8	70.0	71.0	65.8	66.0	69.0	66.0	65.5	66.5	62.0	61.0	61.5
20	64.0	70.5	67.5	63.0	68.0	67.5	63.0	67.8	67.0	63.6	67.0	67.0	63.5	64.5	65.0	63.5	63.5	64.0	61.0	60.8	60.5
21	63.5	69.0	58.0	61.5	69.0	58.5	61.0	68.7	60.0	61.0	67.0	61.0	61.0	63.5	62.0	62.0	62.5	62.5	60.0	60.0	59.8
22	50.0	69.0	55.0	51.0	60.5	57.0	51.5	59.5	58.8	52.5	58.5	60.0	54.0	56.5	59.5	57.0	56.7	59.0	58.6	57.6	57.8
23	50.0	78.0	62.0	50.0	65.0	61.2	50.0	63.0	64.0	50.8	60.5	64.0	52.5	56.0	61.0	55.0	55.5	59.0	57.0	57.0	56.5
24	55.5	80.5	68.0	54.0	69.8	66.6	54.0	63.0	67.0	54.0	59.6	66.5	55.0	56.5	63.0	56.5	57.0	60.5	57.0	57.0	57.0
25	59.0	84.0	61.5	55.3	70.0	62.0	55.2	69.0	65.0	55.5	65.0	65.0	56.0	59.0	63.5	57.5	58.0	61.5	57.5	57.4	57.4
26	53.0	61.5	64.0	52.8	71.0	63.0	53.0	69.0	66.0	53.6	65.0	66.0	55.0	58.5	64.0	57.0	57.5	61.5	57.6	57.3	57.2
27	54.0	55.0	53.5	53.0	54.0	53.6	53.0	54.8	54.2	53.6	55.0	55.0	55.0	55.0	55.0	57.0	56.5	56.0	57.5	57.0	56.5
28	51.5	72.0	53.0	51.0	60.5	54.0	51.0	61.5	56.0	52.0	58.5	56.8	53.0	55.5	57.0	54.5	55 0	57.0	56.0	55.8	55.6
29	51.0	79.5	60.0	57.5	66.0	60.0	56.0	64.0	61.0	45.6	59.0	61.0	48.0	53.5	59.0	55.0	53.0	57.0	55.0	54.8	54.8
30	62.0	86.0	72.0	56.5	71.8	70.0	54.7	69.5	70.0	54.0	65.0	69.5	53.5	58.5	65.0	55.0	56.5	61.5	55.2	55.2	56.0
31	66.0	73.0	64.0	63.5	67.6	63.5	63.0	66.0	64.0	62.6	65.0	64.0	61.0	62.5	63.0	60.5	61.0	61.5	57.0	57.5	57.5

READING OF SOIL THERMOMETERS..—(*Continued*).

1889.		SURFACE.			ONE INCH.			TWO INCHES,			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
		7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
June	1	58.0	61.0	60.0	58.8	60.3	60.0	60.3	60.7	61.2	61.0	60.5	62.0	61.0	59.5	61.5	60.5	60.0	60.5	58.0	57.2	58.0
	2*	63.0	69.0	60.5	....	61.5	60.0	....	60.5	60.0	....	60.0	60.6	....	58.0	60.0	....	....	....	....	....	....
	3	60.0	68.0	63.5	57.4	65.5	62.0	56.3	64.0	67.0	56.0	62.0	63.0	56.0	59.0	61.0	....	....	....	....	....	....
	4	59.5	73.0	63.0	57.4	70.0	63.0	56.8	69.0	64.0	56.6	64.6	64.3	56.5	60.0	63.0	....	....	....	....	....	....
	5	56.0	63.5	59.0	55.0	61.0	59.2	55.3	62.8	61.5	55.0	60.7	62.8	56.0	58.0	61.5	....	....	....	....	....	....
	6	52.0	72.0	60.0	52.0	65.2	61.0	52.0	65.0	62.8	53.5	61.5	64.5	55.0	57.5	61.5	....	....	....	....	....	....
	7	59.0	76.0	62.0	55.6	68.0	60,8	54.2	66.0	62.0	63.5	61.0	61.8	54.0	57.0	60.0	....	....	....	....	....	....
	8	60.0	66.0	65.0	59.0	63.0	64.0	59.0	62.8	64.0	59.0	61.0	63.0	58.0	59.0	61.0	....	....	....	....	....	....
	9	67.0	85.5	72.0	64.5	77.7	71.8	64.0	75.0	72.0	62.5	70.8	71.0	60.0	64.5	67.7	....	....	....	....	....	....
	10	72.0	79.0	71.5	68.0	74.0	73.3	67.0	72.8	74.5	65.5	70.0	74.8	64.5	66.0	71.0	....	....	....	....	....	....
	11	64.0	67.0	64.0	62.3	65.0	64.0	62.0	65.0	65.0	62.0	64.0	65.0	62.5	63.0	64.0	....	....	....	....	....	....
	12	63.0	76.0	70.0	60.0	73.5	69.0	59.0	69.5	69.0	58.6	66.5	68.7	59.0	62.5	66.0	....	....	....	....	....	....
	13	67.0	88.0	73.5	60.8	75.0	72.0	61.5	76.5	73.6	60.6	71.0	73.0	60.0	65.0	69.5	....	....	....	....	....	....
	14	67.5	94.0	80.0	65.0	81.0	77.8	64.0	80.0	78.7	63.0	74.5	77.6	63.0	67.0	72.5	....	....	....	....	....	....
	15	71.5	79.0	73.0	69.5	75.8	72.7	69.0	73.8	72.8	68.0	72.0	72.0	67.3	69.0	70.0	....	....	....	....	....	....
	16	67.5	88.5	71.0	67.0	82.0	72.0	66.5	79.2	72.6	66.3	76.5	73.3	66.0	70.7	71.5	....	....	....	....	....	....
	17	67.5	80.0	68.0	67.0	74.0	69.7	67.0	72.0	71.0	67.0	69.5	71.8	67.0	67.0	70.0	....	....	....	....	....	....
	18	61.5	81.5	72.0	60.0	75.0	72.0	59.5	74.0	71.6	59.2	70.0	71.0	60.5	65.0	69.0	....	....	....	....	....	....
	19	57.5	59.8	71.5	57.0	59.3	69.6	58.8	59.5	68.7	60.0	60.0	67.3	62.0	60.3	65.0	....	....	....	....	....	....
	20	66.0	87.0	72.5	63.0	80.5	75.5	64.0	81.0	77.0	64 5	74.0	76.5	63.5	67.5	73.0	....	....	....	....	....	....
	21	68.0	90.0	71.5	64.0	80.0	70.7	64.0	80.0	70.7	63.6	74.0	70.0	64.0	67.4	68.5	....	....	....	....	....	....
	22	64.0	70.0	63.0	61.3	65.0	64.0	61.8	65.0	64.8	62.0	64.0	65.6	63.0	63.0	65.0	....	....	....	....	....	....
	23	60.0	82.0	68.0	56.6	76.0	68.6	56.8	75.8	70.9	56.0	69.2	70.9	57.5	63.5	67.6	....	....	....	....	....	....
	24	57.0	74.5	66.0	56.3	70.6	....	56.0	69.0	76.0	57.0	65.5	67.0	59.0	61.5	65.5	....	....	64.0	....	....	63.5
	25	59.5	76.0	70.0	60.8	73.4	71.6	58.0	69.8	70.0	58.5	66.5	69.5	59.5	62.0	66.5	60.5	61.0	63.5	62.0	62.0	62.0
	26	64.0	80.0	71.0	64.4	77.0	73.4	62.0	72.0	71.0	62.0	69.0	71.7	62.0	65.0	69.0	62.0	62.5	65.5	62.0	62.0	62.0
	27	67.0	82.5	68.0	68.0	80.6	78.8	66.0	78.0	76.5	66.0	74.0	76.0	65.5	68.5	72.5	64.5	65.0	68.5	63.0	63.5	63.5
	28	70.0	89.0	78.0	69.8	82.4	78.8	68.0	79.8	78.8	67.5	74.8	78.0	67.0	69.0	74.5	66.5	67.0	70.0	64.5	64.5	65.0
	29	69.0	90.0	77.5	69.8	86.0	80.6	66.8	83.0	80.0	66.5	77.0	80.0	66.5	70.0	75.5	66.5	67.0	71.0	65.5	65.5	65.5
	30	73.0	96.0	83.0	71.6	89.6	84.2	68.8	86.5	83.8	67.0	79.5	83.0	67.0	71.5	78.0	67.0	67.8	72.5	66.2	65.6	66.3

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* These thermometers displaced and thrown away the previous night, and the record for previous day taken. All were found and the unbroken ones replaced. The record is lost at those depths for which new thermometers had to be made, until the new ones were received from Henry J. Green, New York.

READING OF SOIL THERMOMETERS — (*Continued*).

1889.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
July 1	75.0	90.0	73.0	75.2	86.0	77.0	71.8	81.0	78.0	70.7	78.0	78.5	70.5	73.0	75.5	70.0	70.0	72.0	67.5	67.5	67.5
2	70.0	80.0	74.0	71.6	78.8	75.2	70.0	76.0	74.3	70.0	73.8	74.8	70.0	70.5	73.0	69.0	69.0	70.5	67.5	67.5	67.5
3	75.0	91.0	80.0	73.4	86.0	80.6	71.0	83.0	80.0	69.6	78.7	79.6	69.0	73.0	76.0	68.5	69.5	72.5	67.5	67.5	67.5
4	67.0	85.0	76.0	69.8	80.6	77.0	68.0	79.8	76.4	69.5	76.0	76.6	70.5	71.5	74.5	70.5	70.0	71.5	68.0	68.0	68.0
5	66.0	90.5	74.0	66.2	83.3	77.0	65.0	81.7	78.0	65.0	76.0	78.6	66.5	70.0	75.0	67.0	68.0	71.5	68.0	67.5	67.5
6	68.0	95.5	74.0	66.2	86.0	80.6	63.0	84.0	79.8	62.6	77.0	80.0	64.5	69.5	75.5	66.5	67.0	71.5	67.5	67.0	67.0
7	72.0	100.0	84.0	69.8	89.6	84.2	66.4	88.0	84.5	65.0	80.0	83.6	66.0	71.5	78.5	67.5	68.5	73.5	67.5	67.5	67.6
8	67.0	103.0	84.5	73.4	93.2	86.0	71.0	90.0	86.0	70.0	83.0	86.0	70.0	74.5	81.0	70.0	71.0	75.5	68.5	68.5	69.0
9	78.0	103.5	87.0	77.0	98.6	89.6	74.0	93.0	78.4	72.8	85.7	77.6	72.3	77.5	83.0	72.0	73.0	77.0	69.5	70.0	70.0
10	80.0	108.0	88.0	77.0	98.6	89.6	75.5	92.0	89.0	74.5	86.7	78.8	74.0	79.0	84.0	73.5	75.0	78.0	71.0	71.0	71.0
11	75.0	88.5	80.0	75.2	84.2	82.4	73.8	81.6	81.5	74.3	79.0	81.6	74.5	75.5	78.5	74.5	74.0	75.5	71.5	71.5	71.0
12	76.0	93.0	83.0	73.4	89.6	86.0	72.0	87.0	85.0	70.8	82.0	85.0	71.0	75.0	80.5	72.0	72.5	76.0	71.0	71.0	71.0
13	75.0	94.0	86.0	73.4	91.4	86.0	71.3	87.0	85.8	71.7	81.6	85.0	71.2	75.0	80.5	72.0	72.5	76.0	71.0	71.0	71.0
14	72.0	99.0	74.0	73.4	86.0	77.0	70.2	83.7	77.8	71.0	79.0	78.0	71.5	74.0	76.0	72.0	72.0	74.0	71.0	71.0	70.5
15	64.0	81.5	69.5	66.2	75.2	73.4	64.8	73.8	72.5	66.0	71.8	73.6	68.0	69.5	72.0	69.5	69.0	70.5	70.0	69.6	69.5
16	66.0	92.0	78.0	64.4	80.6	78.8	62.7	80.0	78.6	63.0	74.5	78.0	65.0	69.0	74.5	67.0	67.5	71.0	69.0	68.5	68.0
17	71.5	98.0	79.0	71.6	89.6	80.6	68.0	85.0	80.5	67.0	78.8	80.0	67.5	71.6	76.5	68.0	69.0	73.0	68.5	68.5	68.5
18	70.0	98.2	82.1	71.6	86.0	82.4	68.0	85.0	82.0	68.0	79.0	81.5	69.0	72.7	77.8	69.5	69.5	73.5	69.0	68.5	68.5
19	74.0	71.0	71.5	73.4	75.2	71.6	71.0	72.5	71.0	70.0	73.0	71.0	70.0	72.0	70.5	70.5	70.5	70.0	69.5	69.5	69.0
20	68.0	73.0	69.5	69.8	73.4	71.6	68.0	71.0	69.8	68.8	70.0	70.0	68.5	69.0	69.5	69.0	68.5	69.0	68.5	68.5	68.0
21	67.0	84.0	76.0	66.2	82.4	77.0	64.8	78.8	77.2	64.8	74.8	77.6	65.5	69.8	74.5	66.5	67.5	71.0	68.0	67.5	68.0
22	67.0	90.0	79.5	66.2	84.2	82.4	64.5	80.0	80.5	64.7	76.0	80.0	66.0	70.0	76,5	67.0	68.0	71.5	68.0	68.0	68.0
23	69.0	97.5	76.0	69.8	86.0	80.6	68.0	82.0	79.0	68.0	78.0	79.8	68.3	72.0	76.5	69.0	69.5	72.5	68.5	68.5	68.5
24	66.0	93.5	74.5	66.2	82.4	78.8	64.0	78.3	77.8	64.4	73.5	78.0	66.0	68.5	74.5	68.0	68.0	71.0	68.5	68.5	68.0
25	66.0	91.0	77.0	64.4	86.0	78.8	62.8	81.0	77.5	66.0	76.0	78.2	65.0	69.5	74.5	67.0	67.5	70.5	68.5	68.0	67.5
26	67.5	96.0	75.0	66.2	86.0	80.6	64.0	81.0	79.6	64.5	76.0	79.6	66.0	70.3	76.0	67.0	68.0	72.0	68.0	68.0	68.0
27	63.5	73.0	77.0	66.2	73.4	77.0	65.0	69.8	76.0	66.7	68.2	75.5	68.0	67.5	72.5	69.0	67.5	69.5	68.5	68.0	68,0
28	73.0	82.6	78.0	73.4	82.4	80.6	69.8	78.0	78.7	69.0	75.5	78.0	68.5	71.5	74.5	68.3	69.0	71.5	68.0	68.0	68.0
29	72.0	84.0	77.0	73.4	78.8	78.8	71.0	74.8	77.0	70.6	72.6	77.0	70.0	70.7	74.0	69.8	69.5	71.5	68.8	68.6	69.5
30	69.5	76.0	73.5	71.6	77.0	77.0	69.0	74.5	74.5	69.7	72.7	75.0	69.5	74.5	73.5	69.5	69.5	71.0	68.5	69.0	69.0
31	69.0	76.6	73.0	69.8	82.4	77.0	67.8	77.5	76.0	68.0	74.7	76.0	68.5	71.0	74.5	69.0	69.0	71.5	69.0	69.0	69.0

READING OF SOIL THERMOMETERS — (*Continued*).

1889.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
August 1	70.0	84.2	80.0	69.5	73.5	78.5	69.7	73.5	79.0	70.0	72.0	78.0	69.5	70.0	75.0	70.0	69.0	75.0	69.0	68.5	67.5
2	70.0	83.0	74.0	68.0	76.5	75.5	68.0	75.5	75.6	68.2	73.5	75.6	68.8	71.0	73.5	69.0	69.5	71.5	69.0	69.0	69.5
3	71.0	88.0	74.0	69.5	82.0	75.5	68.5	79.0	76.7	68.7	76.0	77.0	69.0	71.5	75.3	69.5	71.5	72.5	69.5	69.5	69.5
4	67.0	80.5	76.0	64.0	79.5	77.5	64.6	78.5	78.0	64.8	74.6	77.5	66.5	70.0	74.0	68.0	68.5	71.0	69.5	69.0	69.0
5	65.5	87.5	75.0	65.5	78.5	77.0	65.6	74.5	78.0	66.5	71.8	77.0	67.5	68.5	74.0	68.5	68.0	71.0	69.0	68.5	67.5
6	66.0	92.0	77.5	62.5	84.0	79.5	62.0	78.0	80.6	62.0	74.2	80.0	64.0	68.5	75.5	66.0	67.0	71.0	68.5	68.3	68.0
7	66.0	92.0	77.0	63.0	83.0	79.0	63.0	78.5	79.6	63.0	74.5	79.0	64.5	69.0	75.0	66.5	67.0	71.0	68.5	68.0	68.0
8	64.0	85.0	73.5	62.0	78.0	74.0	61.0	75.5	75.0	62.6	72.6	75.5	64.5	68.0	73.0	66.5	66.5	70.0	68.5	68.0	68.0
9	66.0	76.0	70.0	66.0	73.0	70.0	66.0	73.0	70.0	67.0	71.0	70.0	67.5	68.6	69.5	68.0	68.5	69.5	68.0	68.0	68.0
10	67.0	84.0	70.0	65.0	79.0	63.5	65.5	76.5	73.8	65.7	74.0	74.5	66.0	69.5	73.0	67.5	67.5	70.0	67.5	67.5	67.5
11	64.0	80.0	66.0	61.5	74.0	69.5	61.7	70.2	70.0	62.0	69.0	71.0	63.5	66.5	69.8	65.5	65.5	68.0	67.5	67.0	67.0
12	60.0	79.0	68.0	58.5	73.5	69.5	58.5	70.5	69.5	59.7	67.6	69.3	61.5	64.5	68.0	64.0	64.0	66.5	67.0	66.5	66.0
13	62.0	68.0	70.5	62.0	66.0	71.0	62.5	65.7	71.0	63.0	64.8	70.8	64.0	64.0	68.7	65.0	64.5	66.5	66.0	65.0	66.0
14	66.0	68.0	71.5	65.5	68.0	71.5	65.3	68.5	71.5	65.5	68.0	71.0	65.5	66.5	69.5	65.5	66.5	67.0	66.0	66.0	66.0
15	60.5	72.0	64.0	61.0	69.0	67.0	61.0	68.0	67.6	61.5	66.0	67.0	64.0	64.5	67.0	65.0	64.5	66.0	66.0	66.0	66.0
16	58.0	76.0	69.0	57.5	69.5	69.5	57.0	68.0	70.0	57.8	66.0	69.8	60.0	63.5	67.5	62.0	62.5	65.5	65.5	65.0	65.0
17	61.0	79.0	68.0	59.5	73.5	69.0	59.0	71.5	69.2	59.6	68.5	69.5	61.0	64.5	68.0	63.0	63.5	66.0	65.0	65.0	65.0
18	59.0	89.0	72.0	58.5	75.4	73.0	58.5	73.5	74.0	59.5	69.4	73.5	61.0	65.0	70.0	63.0	63.0	67.0	65.0	64.4	65.0
19	63.5	84.0	71.5	62.0	76.5	71.0	62.0	74.5	71.2	62.5	70.5	70.8	63.5	66.0	69.0	64.5	64.5	67.0	65.5	65.5	65.5
20	70.0	90.0	76.0	67.0	81.0	75.5	67.0	79.0	75.8	66.8	75.5	75.5	66.5	70.0	73.0	66.0	67.0	70.0	66.0	66.0	66.5
21	68.0	92.0	74.5	67.5	81.5	76.0	67.8	80.0	77.0	68.0	76.0	77.0	68.4	71.0	74.5	68.0	68.5	71.5	67.0	67.0	67.5
22	68.5	89.0	73.0	64.5	76.5	75.0	65.0	75.0	76.0	65.3	72.0	76.0	66.5	68.5	73.0	67.5	67.5	70.0	68.0	67.5	67.5
23	65.5	90.0	74.0	62.0	80.0	75.0	62.0	77.0	75.8	62.0	72.7	75.8	64.0	68.0	73.0	66.0	66.0	70.0	67.5	67.0	67.0
24	65.0	92.0	74.0	63.0	81.0	66.5	63.5	79.5	78.0	64.0	74.0	78.0	65.0	69.0	74.5	66.0	67.0	70.5	67.5	67.0	67.0
25	64.0	94.0	75.0	63.0	80.5	78.0	63.8	78.8	79.0	63.0	73.5	79.0	65.0	68.5	75.0	66.5	67.0	71.0	67.5	67.5	67.5
26	60.0	91.5	76.0	60.0	81.0	77.5	60.6	78.0	78.7	62.0	73.0	78.5	64.5	68.0	74.5	66.0	66.5	70.0	67.5	67.5	66.5
27	61.0	86.5	75.5	61.0	76.0	76.7	62.2	75.2	78.0	63.0	71.5	78.0	65.0	67.5	74.0	66.0	66.0	70.0	67.0	67.4	66.7
28	63.0	96.0	76.0	61.5	80.5	77.5	61.5	78.7	78.5	62.2	73.0	78.5	64.0	67.5	74.8	65.5	66.0	70.5	67.0	66.7	66.5
29	62.0	95.0	77.5	60.5	80.0	77.7	60.7	78.7	79.0	61.7	73.0	79.0	64.0	67.5	75.0	65.5	66.0	70.5	67.0	66.7	66.5
30	61.5	99.0	78.0	60.5	81.5	77.7	61.0	80.0	79.0	62.0	74.0	78.5	64.0	68.0	75.0	65.5	66.0	70.5	67.0	66.7	66.7
31	64.0	95.0	73.0	62.5	81.0	75.5	63.0	80.0	77.0	63.7	74.5	77.2	65.2	68.7	74.5	66.5	66.5	70.5	67.0	67.0	66.7

READING OF SOIL THERMOMETERS — (*Continued*).

1889.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
September 1	61.0	92.0	74.0	60.0	77.5	76.0	60.2	77.0	77.0	61.5	72.0	77.0	63.5	67.0	74.0	65.5	65.5	70.0	67.0	66.5	67.0
2	65.0	91.0	76.0	64.5	79.5	78.0	65.0	79.0	79.0	65.0	74.5	78.8	66.5	69.5	75.5	67.0	67.5	71.0	67.5	67.5	67.5
3	67.0	95.5	77.0	65.5	82.0	78.5	66.0	81.0	79.8	66.8	76.0	79.7	67.5	70.5	76.5	68.0	68.0	72.3	68.0	67.8	68.0
4*	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
5*	69.0	95.0	76.0	67.5	79.5	76.0	....	....	....	....	75.0	76.0	....	....	....	....	....	....	....	....	....
6	....	66.0	64.0	....	65.0	66.0	....	....	....	....	66.0	67.5	....	....	....	....	....	....	....	....	....
7	60.0	70.0	66.0	57.0	67.0	66.0	....	....	....	58.2	65.3	67.0	....	....	....	....	....	....	....	....	....
8	64.0	76.0	71.0	63.5	73.5	72.5	....	....	....	64.0	70.0	73.0	....	....	....	....	....	....	....	....	....
9	66.0	86.0	72.0	44.5	78.0	74.5	....	....	....	65.0	74.0	76.0	....	....	....	....	....	....	....	....	....
10	63.0	87.0	72.0	62.0	77.0	74.0	....	....	....	63.5	73.5	76.0	....	....	....	....	....	....	....	....	....
11	64.0	98.5	71.0	62.5	78.5	74.5	....	....	....	63.3	75.5	77.0	....	....	....	....	....	....	....	....	....
12	62.0	98.0	72.0	61.0	78.0	74.5	....	....	....	63.0	75.0	77.2	....	....	....	....	....	....	....	....	....
13	66.0	84.0	70.0	65.0	76.5	70.0	....	....	....	65.5	84.0	72.0	....	....	....	....	....	....	....	....	....
14	68.0	84.0	73.5	66.0	78.0	74.0	....	....	....	66.0	75.0	76.0	....	....	....	....	....	....	....	....	....
15	67.0	83.0	73.5	66.0	78.5	74.0	....	....	....	66.5	76.3	76.0	....	....	....	....	....	....	....	....	....
16	68.0	66.0	62.5	67.5	67.0	63.5	....	....	....	68.0	68.7	66.0	....	....	....	....	....	....	....	....	....
17	60.0	66.0	64.0	59.5	62.5	64.0	....	....	....	61.0	62.5	64.0	....	....	....	....	....	....	....	....	....
18	54.0	62.0	54.0	55.5	63.5	57.0	....	....	....	58.0	63.0	60.3	....	....	....	....	....	....	....	....	....
19	54 5	64.0	52.5	51.5	60.0	55.0	....	....	....	53.0	58.0	58.0	....	....	....	....	....	....	....	....	....
20	50.5	54.0	53.0	51.5	54.3	53.0	....	....	....	53.0	55.0	55.0	....	....	....	....	....	....	....	....	....
21	50.5	57.0	50.0	51.0	55.0	51.5	....	....	....	52.0	54.5	53.3	....	....	....	....	....	....	....	....	....
22	46.0	68.0	52.5	46.0	57.5	55.5	47.0	59.0	57.0	48.5	56.5	58.0	51.0	53.5	57.0	53.0	54.0	56.5	62.5	63.5	63.0
23	45.0	76.0	56.0	46.0	63.0	59.5	46.0	65.5	61.0	48.0	60.7	62.0	50.5	55.0	60.0	53.0	54.2	58.5	62.7	62.5	62.5
24	52.0	78.0	62.0	53.0	66.5	64.0	53.3	68.0	65.0	54.5	64.2	66.0	55.5	58.7	63.0	57.0	58.5	61.2	63.7	63.7	64.0
25	50.5	74.0	60.0	50.5	64.0	61.5	49.5	64.7	62.5	52.0	61.5	63.2	53.5	57.5	61.0	55.3	56.0	59.5	63.0	63.0	63.2
26	56.5	55.5	50.0	58.0	56.0	53.5	58.5	56.5	54.5	59.5	57.6	56.0	59.5	58.0	57.0	59.5	59.0	58.0	65.0	65.0	64.5
27	44.0	60.0	50.0	46.0	56.5	52.0	47.0	58.0	53.0	49.0	56.0	54.5	52.0	54.0	55.0	54.5	54.5	55.5	64.0	63.5	63.0
28	46.0	61.0	52.2	47.5	59.5	55.5	48.0	58.5	56.5	49.6	56.8	58.0	51.5	54.7	56.5	53.5	54.0	56.0	62.5	62.2	63.0
29	44.5	73.5	58.5	46.0	62.0	61.5	46.5	63.5	61.0	48.5	60.0	63.0	51.0	54.5	60.0	53.0	54.0	58.0	62.0	62.0	62.0
30	56.0	60.0	58.0	56.5	59.5	58.9	56.5	59.5	59.0	57.0	59.0	59.0	56.5	57.0	58.0	57.0	57.0	57.5	62.5	62.5	63.0

* Thermometers disturbed again. All were found. The record was lost for the depths at which we could make no substitution for the broken ones until new ones could be made and set.

READING OF SOIL THERMOMETERS — (*Concluded*).

1889.	SURFACE.			ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCH'S		
	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M,	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.	7 A.M.	12 M.	6 P.M.
October 1	56.0	69.0	56.0	56.5	64.5	57.0	56.8	65.0	57.5	57.5	63.0	58.0	57.0	59.0	58.5	57.5	58.0	58.5	63.0	63.5	63.3
2	47.5	52.0	48.0	49.5	51.5	51.0	50.5	51.5	52.0	52.6	52.0	54.0	54.5	53.0	54.5	56.0	55.0	55.0	63.0	63.0	63.0
3	45.0	51.0	51.5	46.0	51.0	50.5	46,0	50.5	51.5	47.0	50.8	52.0	49 0	50.5	51.5	51.5	51.7	52 5	61.5	61.0	61.0
4	48.0	50.7	48.0	48.5	50.7	47.8	49.0	50.8	48.5	50.0	51.0	50.0	51.0	51.0	51.0	52.5	52.0	52.0	60.5	60.5	60.0
5	42.0	47.5	48.0	44.0	47.5	48.0	44.5	47.5	48.5	46.0	47.5	49.0	48.0	48.0	49.5	50.3	50.0	50.5	59.5	59.5	59.0
6	48.0	48.5	46.0	48.5	47.5	47.0	48.5	48.0	48.0	49.0	49.0	48.3	49.5	49.5	49.5	50.5	50.5	49.5	59.0	59.0	58.5
7	42.0	53.5	41.5	43.0	50.0	44.0	43.5	48.7	44.5	44.8	48.0	46.0	46.5	47.5	47.7	48.5	48.5	49.0	58.0	58.0	57.5
8	39.5	56.0	44.0	40.5	49.0	47.0	41.0	50.0	48.0	42.5	48.5	49.5	45.0	46.0	49.5	47.0	47.0	49.5	57.0	57.0	56.5
9	42.2	51.5	47.5	43.0	49.5	48.5	43.0	48.5	48.5	44.0	48.0	49.0	45.5	47.0	48.5	47.5	48.0	49.0	56.5	56.5	56.5
10	41.5	58.0	50.0	43.0	54.5	49.5	43.5	56.0	51.0	45.0	53.6	53.0	47.0	49.5	52.5	48.5	49.0	51.5	56.5	56.7	56.5
11	42.0	48.0	51.5	43.0	54.0	53.0	43.5	53.5	54.0	45.0	50.6	54.7	46.5	48.5	53.0	48.5	48.5	52.0	57.0	57.0	57.0
12	46.0	62.5	48.0	46.5	57.0	49.5	46.5	55.5	50.0	47.6	53.0	52.0	48.5	50.0	52.0	49.5	50.0	52.0	57.5	57.0	57.5
13	43.0	48.0	44.0	44.3	47.0	45.5	44.6	47.0	46.0	46.0	47.2	47.2	47.5	47.5	48.0	49.5	49.0	49 0	57.5	57.0	57.0
14	40.0	62.0	44.0	41.5	53.0	47.5	41.5	55.5	49.0	43.0	52.7	50.7	45.5	48.0	50.5	47.5	48.0	50.5	56.5	56.5	57.0
15	38.5	67.0	47.0	40.5	54.0	50.5	41.0	56.6	53.0	43.0	43.5	44.6	45.0	48.5	53.0	47.0	48.0	52.0	56.5	56.5	56.0
16	40.0	70.0	49.5	41.5	56.5	53.5	42.0	59.0	56.5	43.7	55.0	57.0	45.7	49 5	54.8	48.0	48.5	53.0	56.5	56.5	56.5
17	43.0	66.0	52.0	44.5	56.5	53 5	44.6	55.0	54.0	46.0	52.0	55.0	47.5	49.5	53.0	49.0	49.5	52.0	57.0	57.0	57.0
18	39.0	64.0	47.0	41.5	55.7	51.0	42.0	54.0	53.5	44.0	52.0	55.0	47.0	49.0	53.5	49.0	49.0	52.0	57.0	56.6	56.5
19	37.0	63.0	48.0	39.7	54.0	51.0	40.5	54.5	52.5	43.0	51.8	54.0	45.5	47.5	52.5	48.0	48.0	51.0	56.5	56.5	56.0
20	48.0	46.0	42.0	48.5	47.5	45.5	49.0	48.0	46.3	50.0	49.0	47.5	49.7	49.[illegible]	48.0	50.0	49.7	49.0	56.5	56.5	56.5
21	33.0	60.0	40.0	36.5	49.5	45.5	37.2	52.0	47.0	39.5	48.8	49.0	42.5	45.0	49.0	45.5	45.6	48.6	55.5	55.5	55.0
22	33.0	53.0	41.5	35.5	46.5	42.5	36.0	45.5	43.7	38.5	44.5	45.0	41.5	43.0	45.0	44.4	44.5	45.0	54.5	54.5	54.0
23	30.0	55.0	34.0	33.6	44.6	32.0	35.0	48.5	34.5	38.0	45.5	36.5	41.0	42.5	36.7	44.0	43.5	36.5	53.5	53.5	53.0
24	29.0	51.5	39.0	32.0	43.5	43 0	33.0	45.3	44.5	35.2	42.2	46.0	38.6	39.7	45.0	41.5	41.5	45.0	52.5	52.3	52.0
25	34.0	42.5	42.0	36.0	42.0	43.0	36.5	41.5	44.0	38.0	41.0	44.5	40.0	41.0	43.5	42.0	42.0	44.0	52.0	51.5	51.5
26	43.5	57.5	48.0	43.5	51.0	48.5	43.5	49.0	49.0	43.5	47.2	49.0	43.5	45.0	48.0	44.0	44.6	46.7	51.5	52.0	52.0
27	47.0	50.0	48.0	47.0	49.5	48.5	47.0	49.5	48.5	47.3	49.0	49.0	47.0	47.5	48.5	47.0	47.0	49.0	53.0	53.0	53.0
28	44.0	46.0	42.0	44.5	45.5	42.5	44.5	45.5	43.5	45.5	46.0	45.0	46.0	46.0	45.5	47.0	46.5	46.5	53.5	53.5	53.0
29	42.0	44.0	42.0	42.5	44.5	43.0	42.5	44.5	43.5	43.0	44.8	44.5	44.0	44.5	45.0	45.0	45.0	45.5	53.0	53.0	52.5
30	37.5	47.0	42.0	39.5	45.5	42.5	40.0	45.0	42.5	41.5	44.5	44.2	43.0	43.5	44.5	44.5	44.5	45.0	52.5	52.5	52.5
31	41.5	45.0	46.0	42.0	45.0	45.5	42.0	44.5	45.5	42.5	44.8	46.0	43.0	44.0	45.5	44.5	44.5	45.5	52.5	52.0	52.0

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